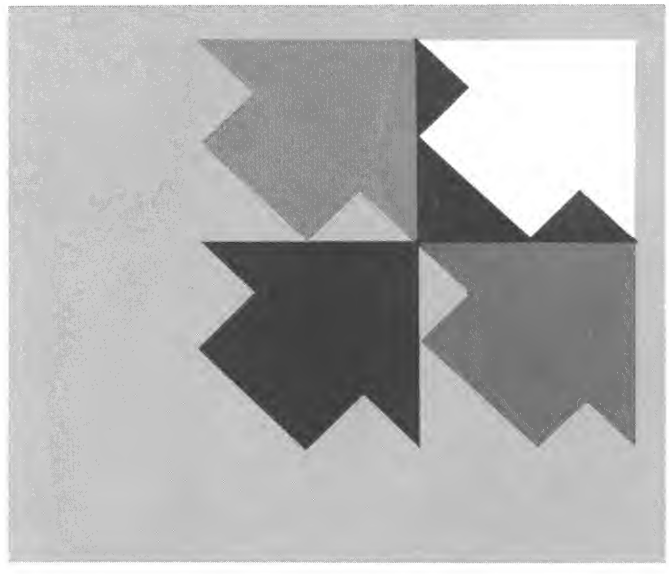
Snapshot of

INTELLIGENT TERMINALS

by Auerbach



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CONTENTS

	Page
PREFACE	iii
AUERBACH On . . .	
Intelligent Alphanumeric Displays	1
PRODUCT REPORTS	
Applied Digital Data Systems	
System 70	7
Beehive	
B 500 Computer Terminal	11
Bunker Ramo	
System 90 Intelligent Terminal Display System	15
Burroughs	
TC Series Terminal Computers	19
Computek	
Series 200 Programmable Data Terminals	25
Series 216 Intelligent Terminal System	31
Data Terminals & Communications	
Microfile Computer System	35
Datapoint	
1100 and 1500 Series Intelligent Terminals	37
Digital Equipment	
DECstation 78	47
Four-Phase Systems	
System IV Intelligent Terminals	51
Harris	
Series 800 and 8000 Terminal Systems	57
Honeywell Information Systems	
DST 6/500 Distributed Systems Terminal	63
Imlac	
PDS Graphic Display Computer	67
Incoterm	
SPD 10 Family of Intelligent Terminals	75
SPD 20 Family of Intelligent Terminals	81
Inforex	
System 7000 Intelligent Terminal	87
International Business Machines	
3735 Programmable Buffered Terminal	91
3790 Communication System	95
International Computers	
1500 Intelligent Terminal Systems	103
Magnavox Government & Industrial Electronics	
Orion-60 Plasma Display Terminal	109
Megadata Comp. & Communications	
System 700	113
Mohawk Data Sciences	
Series 21 Distributed Information Systems	117
2300 Document Processing System	123
Ontel	
OP-1 Programmable Terminal	129
Raytheon Data Systems	
PTS–100	133

CONTENTS (CONT)

Page

Sycor
- 250 Series Intelligent Display Systems 141
- 290 Display System 145
- Model 340 & 350 Intelligent Communication Terminal Systems 151
- 400 Series Processing Systems 157

Tektronix
- 4006 and 4010 Series Graphic Display Terminals 163
- 4081 Interactive Graphics System 167

Texas Instruments
- 742 Programmable Terminal 171
- Model 770 Programmable Data Terminal 177

Univac
- Universal Terminal System (UTS) 400 183

DIRECTORY OF SUPPLIERS 189

PREFACE

The electronic data processing industry has a fairly good record for a vocabulary that is descriptive. One term that detracts from this good record is the term *Intelligent Terminal*. One conjures a picture of a stylish terminal that is capable of decision making. Actually the term simply means that the terminal is programmable. That means its logic, its special purpose function, or both can be set and altered by software.

Without exception such terminals support communications to local or remote computers. The recent trend is to include mass storage capabilities among the offered options. These programmable devices, with communications and mass storage attachments, begin to lose the right to call themselves terminals and begin to earn the right to call themselves minicomputers. The more powerful offerings are, in reality, full-fledged computers that have been mislabeled.

It is the trend toward distributed processing that has fostered the offerings of powerful intelligent terminals — terminals with a number (cluster) of CRTs and printers capable of performing data processing functions as well as the classic terminal functions of data entry, report generation, and communications with a host computer.

As this trend continues, terminals will be reduced to two classifications: dumb or nonintelligent terminals that are operated by a host computer and computer-terminals or intelligent terminals that operate like miniature mainframes.

Thirty-four of the most popular intelligent terminals are reported in significant detail in this Snapshot. The reports include the famous and the mighty terminal manufacturers and their lesser known competitors. Also included in this Snapshot is a Directory of Suppliers of intelligent terminals.

AUERBACH On . . . Intelligent Alphanumeric Display Terminals

OVERVIEW

Intelligent alphanumeric display terminals consist of CRT and non-CRT displays. The CRT (Cathode Ray Tube) version is by far the most popular and is employed by a majority of the alphanumeric display terminal vendors. The non-CRT variety features LED (Light-Emitting Diode) displays which are used in solid-state calculators, and Plasma (Gaseous) displays currently incorporated by IBM and Burroughs self-scan display terminals. Considered to be the fastest growing segment of the data processing industry today, intelligent alphanumeric display terminals account for approximately 15 percent of all terminals installed. This growth can be directly attributed to: (1) the recent development of the minicomputer and microprocessor, which provide the intelligence to control the operations of the terminal, and (2) the increased demand for intelligent-based distributed processing terminal systems.

The Evolution of Intelligent Alphanumeric Display Terminals

Early alphanumeric display terminals were of the nonintelligent variety and utilized CRT (Cathode Ray Tube) display screens. Originally designed as a visual alternative to the teleprinter terminal, the nonintelligent CRT display terminal contained a small screen (by today's standards), had a limited display capacity, and was limited to asynchronous data transmission. A pioneer in the development of CRT display terminals was IBM (who else?). The IBM 2260 became the industry standard from the mid-sixties until 1971, when IBM introduced the 3270 Information Display System. During this period, however, a number of independent vendors (Courier, Delta Data, and GTE/IS) introduced 2260-compatible display terminals with improved edit/format features, larger screen capacities, the ability to handle local and remote peripherals, and a lower price tag. It was to counter these independent offerings that IBM introduced the 3270 Information Display System in 1971. Featuring program-controlled formatting, increased transmission speeds, and a screen capacity twice that of its 2260 predecessor, the IBM 3270 was priced to be more competitive with the independent alphanumeric display terminals.

Not to be outdone, the independents accepted the challenge and began developing plug-compatible replacements for the IBM 3270. Since IBM alphanumeric display terminals were designed to operate under IBM's bisync communications protocol and NCP (Network Control Program) software, the independent vendors (Courier, Four Phase, GTE/IS, Memorex, Raytheon, and Sanders) provided emulation programs to do likewise. Priced below the IBM 3270, the independent alphanumeric display terminals became a popular alternative . . . so much so, that IBM introduced a new communications protocol, Synchronous Data Link Control (SDLC), in late 1974. Designed to provide higher transmission efficiency, SDLC was incorporated with IBM's SNA (Systems Network Architecture) software to support the 3270 Information Display System.

The scramble by the independent vendors to emulate IBM's latest communications protocol was facilitated by the development of the microprocessor. This tiny LSI-chip provided ROM (Read-Only Memory) and PROM (Programmable Read-Only Memory) memories to control the operation of the alphanumeric display terminal, as well as emulation of data communications protocols (including SDLC). However, minicomputer-based alphanumeric display terminal systems provided the same capabilities and more . . . although at a higher price. The appeal of the microprocessor as the controller in an alphanumeric display terminal is primarily due to its low cost and the variety of applications it can handle.

Concurrently, the development of LSI technology brought about new display techniques comparable to those of the CRT display. Both LED and Plasma alphanumeric displays are becoming more popular, but so far are limited to small-screen, self-scan alphanumeric display terminals such as the Burroughs TD 700 and IBM 3604 Teller Display terminals.

TECHNOLOGY AND TRENDS

During the past decade, no segment of the data processing industry has manifested the phenomenal growth (from a technological and functional standpoint) of the intelligent alphanumeric display market. Used primarily in data entry and remote batch processing applications during the late sixties and early seventies, the intelligent alphanumeric display terminals took on additional processing power and data communications capabilities to become an in-

tegral part of today's distributed processing systems. By 1980, intelligent terminals will be designed with a universal host interface and will support word and data processing operations concurrently. The level and extent of this support will be determined by the firmware and software provided by the vendor. BASIC, COBOL, and FORTRAN compilers will facilitate program development; housekeeping functions will be performed by a macro instruction; and complete diagnostics and monitoring will be standard.

The Operating Environment . . . Past, Present, Future

In the past (and ofttimes the present), intelligent display terminals were used as sophisticated data entry devices . . . initiating inquiries, inputting transactions, performing file maintenance, etc. Configured as integral parts of RJE or small-business computer systems, the terminals were also used as operator's consoles to execute application programs (under host control) or enter jobs into the host computer.

Perhaps the most outstanding example of an intelligent alphanumeric display terminal in operation today is one that is configured as part of a distributed processing system. The ability to perform data capture, edit/validation, format, and data entry functions at the local level (independent of the host computer, or prior to transmission to the host computer) reduces data transmission costs as well as host computer processing overhead. In addition, a single intelligent alphanumeric display terminal can be used to control an entire cluster of nonintelligent terminals in a distributed environment.

The similarities between business data processing and word processing will provide the impetus for a sharing of the two technologies in the near future. Some intelligent alphanumeric display stations already use the same basic intelligence for both word and data processing applications . . . to a limited degree. This is true information processing, which is the state-of-the-art of the future.

RATIONALE AND OBJECTIVES

The rationale for implementing intelligent alphanumeric display terminals will vary from installation to installation. The objectives, however — to improve system performance, respond to user needs, reduce operating expenses, and prepare for dynamic changes in the industry — can apply to any company.

Intelligent alphanumeric display terminals are available in a variety of configurations and price ranges. No one single configuration can be considered typical, since each installation possesses its own unique hardware and software requirements. For the potential user considering upgrading his present system/terminal configuration, the new intelligent display terminal(s) must be completely compatible in terms of hardware, software, and communications protocol.

From a performance standpoint, substantial reductions in operating costs can be realized by installing a series of intelligent display terminals to perform a variety of tasks (at the local level) that were previously performed by the host CPU. The operating costs are those required to sustain the normal day-to-day operations of the user's installation.

A by-product of any new intelligent terminal installation is expansion planning. Regardless of how well the terminal operates in the current environment, the user must plan for the future — now. By anticipating changes in hardware technology, vendor-supplied firmware and software, as well as the nature and scope of future applications, the user will be assured of a terminal system that is less vulnerable to obsolescence.

SELECTION CRITERIA

No complete or ready-made formula for evaluating, selecting, and installing an intelligent display terminal system has been devised that will satisfy the demands of both the line manager and his data processing counterpart. The objective of this segment, then, is to provide both with a set of guidelines (or selection criteria) designed specifically for their respective areas.

The Management Viewpoint

The line manager is at a decided disadvantage when it comes to evaluating and selecting data processing equipment. Too often he must rely on his data processing staff to lead him through a maze of technical features (fraught with industry buzzwords) that only serve to make equipment selection more difficult. Management does not have to become immersed in bytes, bauds, transfer rates, ROMs, or PROMs to play an important role in the decision-making process. The line manager should concern himself only with the functional aspects of the terminal rather than its technical characteristics and features. By so doing, and adhering to the same selection criteria used in evaluating and acquiring other types of equipment, user management will regain the control over the company's data processing activity it once exercised.

Vendor Reputation. This is a very important factor that requires a great deal of consideration. For example, is the vendor established in the data processing industry? If so, to what extent and how long? What other types of DP equipment does the vendor manufacture and market? What type of support (technical and maintenance) does the vendor provide? How does the vendor's statement of financial condition and earnings history compare with those of other vendors?

Equipment Reliability. This requirement is closely related to *User Experience and Acceptance* (which follows), since only the most naive user would take the vendor at his word concerning terminal performance. Questions that should be ad-

dressed are: Does the terminal feature LSI or solid-state components? Who manufacturers these components — the vendor or another party? What is the MTBF (Mean Time Between Failure) record in a typical installation? Does the vendor warrant the terminal to be free from defects in parts and labor? If so, for what period?

User Experience and Acceptance. The line manager or user who takes the time to contact other industry users of the terminal will benefit greatly from their experience. Trying to find an installation or set of applications similar to yours might be asking too much from dame fortune. However, by finding out why this terminal/vendor was chosen, whether any installation or operational problems were encountered, what type of service was provided, and the terminal features liked or disliked the most, you will gather beneficial information.

Ease of Operation. This requirement is concerned with the human-engineering features of the terminal. Were the functional components (keyboard and display) designed with the operator in mind? Is the keyboard layout in the familiar correspondence or TTY format? Is the keyboard detachable? Does it feature N-key rollover and a numeric keypad? The display clarity should be excellent with a nonglare screen, and tiltable for operator convenience. Controls should be within easy reach of the operator and simple to operate.

Physical Size. An area often overlooked in the selection process is the physical dimensions and weight of the terminal unit. Most mini- or micro-based terminals are very modular and are housed in attractive, desk-like enclosures. Others are portable and small enough to be mounted atop a normal-sized desk and moved about (from place to place) with relative ease.

Terminal Cost. Perhaps the most important question facing the line manager is: How Much is the Terminal Going to Cost? There's no easy answer, since a number of vendors offer their terminals on an OEM basis only; others who market to the end-user offer a variety of lease, purchase, maintenance, and discount plans. In most cases, the terminal lease price is prorated over a period of years and includes maintenance service. Purchase, which is less expensive in the long run, does not include maintenance coverage. In most cases, maintenance plans are available on a time/materials basis, for complete 24-hour coverage, or for prime-shift coverage only. Discount plans are available in the 5-to-10-percent range for quantity lease or purchase of 10 units or more.

The increased popularity of and demand for intelligent terminals makes purchase a viable alternative. The user can amortize credit on the purchase and sell the terminal at some later time to recover a portion of his cost.

Maintenance Service Provided. Of vital importance to the user should be the type of maintenance service provided by the vendor. Most intelligent terminal vendors (be they major or independent) provide their own maintenance service. Those that do not, generally contract with a major third-party service organization such as Sorbus or Dow-Jones to service their equipment.

Maintenance is usually included in the lease price and covers any contiguous 8-hour period, Monday through Friday. Extra-shift maintenance coverage is optional in most cases.

Availability or Delivery Schedule. This requirement is very simple and straightforward: How soon after the order is placed will the vendor deliver and install the terminal equipment?

Technical Support. Many vendors provide on-site training or technical manuals to familiarize user personnel with the operations and processing capabilities of the terminal.

Technology and Characteristics

Many data processing professionals are reluctant to have user management gain an insight into an area they consider sacrosanct — that of evaluating and selecting computer and intelligent terminal systems. From a technical standpoint, it is a truism that data processing personnel have a much better understanding of the operational concepts and technical characteristics of the equipment.

While some features of an intelligent display terminal are self-explanatory, many others require a detailed explanation to place them in their proper perspective. Different vendors offer different features. Accordingly, in the following segments we will summarize those considered to be the most popular, as well as the most useful.

System Applications. Until quite recently, most intelligent display terminals were relegated to the traditional role of data entry systems. However, recent technological advances have brought about an integration and consolidation of data and word processing functions. The result has been an intelligent display terminal well-suited for:

- Distributed processing.
- Intelligent source data collection and entry.
- Text editing and shared-logic word processing.
- Terminal network control.
- Local I/O processing.

Intelligent Terminal Characteristics. The following is a summary of the operational and functional characteristics of intelligent display terminals.

Terminal Configuration. Intelligent display terminals are available in two basic configurations: stand-alone and cluster. The stand-alone terminal incorporates all functional components (keyboard, display, controller, and communications interface) within a single unit. The clustered terminal configuration consists of multiple, cable-connected display terminals, often located hundreds of feet apart from the terminal controller.

Peripheral devices, consisting of serial matrix printers, tape cassette drives, and flexible-diskettes, may be configured with either type.

Peripheral Device Interface. An intelligent display terminal must have the ability to physically connect to and electrically match a variety of peripheral and data communications devices. Two interfaces are available to facilitate this connection: the standard EIA RS-232 serial interface and the DC current-loop interface for parallel (hardwire) connection. The EIA RS-232, standard is periodically reviewed and revised by the Electronics Industry Association to meet the changing requirements of data communications equipment and facilities.

Programmable Memory. A terminal controller provides the system intelligence to perform and direct the operations of the display terminal and its I/O peripherals. Residing in the terminal controller is the minicomputer or microprocessor memory.

The minicomputer is supported by extensive software modules supplied by the vendor. With the microprocessor, however, a ROM (Read-Only Memory) and PROM (Programmable Read-Only Memory) provide the user with the ability to program the terminal's operations. ROM-resident programs may be created by the user, but are permanent until a new ROM is substituted. PROM-resident programs can be easily modified to accommodate changes in applications, the host computer interface, and communications I/O procedures.

Host Computer Compatibility. The primary advantage of an intelligent display terminal is its ability to be programmed to meet the code and communications protocol requirements of any host processor. The most prevalent code/procedures emulated today are IBM's 3270 BiSync and SDLC protocols. Intelligent display terminals featuring microprocessor memory can accommodate either.

Data Communications Compatibility. The intelligent display terminal contains a communications interface that assures compatibility between terminal and host computer communications.

Proper operation of the terminal with the host computer requires that both utilize the same code and communications protocol. Since an intelligent display terminal is essentially a high-speed communications device capable of transmitting and receiving data at several thousand bits per second, it must operate at a speed compatible with the communications network in which it is configured.

Display Format. The display format is determined by the size of the screen (number of lines × number of characters) and the arrangement of the characters displayed. Display characters are formed by a special character generator that converts the coded (keyboard) input into dots, strokes, or starburst images. The dot is the most popular, with the character formed within a matrix of dots. Only those dots required to form the specific character are highlighted. Characters may be more sharply defined by increasing the number of dots. In the stroke display technique, straight lines are used to connect various points of the character.

CRT screens are by far the most popular display medium for the intelligent terminal; however, LED and Plasma displays, which utilize the same character display techniques, are coming into their own.

Keyboard Arrangement. Regardless of the configuration or mode of operation, most data entered into an intelligent terminal is via an electronic keyboard. This keyboard is available in a variety of styles and arrangements. The three most popular are: TTY (Teletypewriter), Correspondence (Selectric), and ANSI. Seldom, if ever, will the user find competing vendors with an identical arrangement; the number and type of program control/function keys will vary, as will the code-character assignments. Some vendors, however, offer more than one keyboard to satisfy diverse user requirements. The extensive use of electronic keyboards has provided terminal users with a faster, quieter means of data entry, as well as a more reliable method of operation.

Intelligent Terminal Features. In the previous segments, we summarized the operational and functional characteristics of intelligent display terminals. To place these characteristics in their proper perspective requires a close examination of the terminal features. Most of these features are standard, while some are optional.

Cursor Positioning and Display. A cursor is a video indicator that points to the position on the screen where the next character will be displayed. Most cursors operate under program control and their standard movements include left, right, up, down, and home return. In addition, some vendors offer the following features to complement and extend the cursor's functions:

- Blinking cursor — rapid blinking of the cursor to mark its position.
- Automatic tab — forward and reverse cursor movement to the next or previous position.

Reverse Video. A negative or reverse image of the data is displayed to alert the operator, i.e., characters

normally displayed light on a dark background will be displayed dark on a light background. This feature may be designed for a single character, a line, or the entire display.

Paging or Scrolling. To locate a particular line or field of data quickly requires the operator to step or flip through an entire screen (paging), or to scan several fields of data on previous or subsequent lines (scrolling). Data that is paged off the screen can be retained in a buffer for auto recall.

Polling and Addressing. This feature is basic to the efficient utilization of intelligent terminals in a data communications network. Polling solicits or invites data transmission from the terminals, while addressing informs the terminal that a message from the host computer is forthcoming.

Character, Field, and Line Insert Delete. These features, which work in conjunction with the cursor, are designed to provide the operator with comprehensive editing functions.

- Character insert/delete — the ability to insert or delete a character from an existing line of text. In the insertion mode the text expands to accept the extra character, while in the deletion mode the text contracts.
- Field and line insert/delete — the ability to insert or delete a complete field or line of text on the screen. Again, the text will expand or contract to accommodate/remove the field or line.

Split Screen. This feature saves data transmission time and line costs by sending only those characters keyed in by the operator. Fixed characters and blanks are not transmitted.

Numeric Keypad, N-Key Rollover, and Detachable Keyboard. These are features designed to enhance keyboard operations. The numeric keypad is a special set of 10 or 11 numeric keys (arranged in the familiar adding-machine format) designed for high-volume numeric data entry applications. N-key rollover is a keyboard function that enables the operator to continue entering data without the necessity of releasing previously depressed keys. A detachable keyboard may be located some distance away from the display unit for operator convenience.

Integral Modem. An integral modem eliminates the need for an external modem by providing a direct connection to the data communications line.

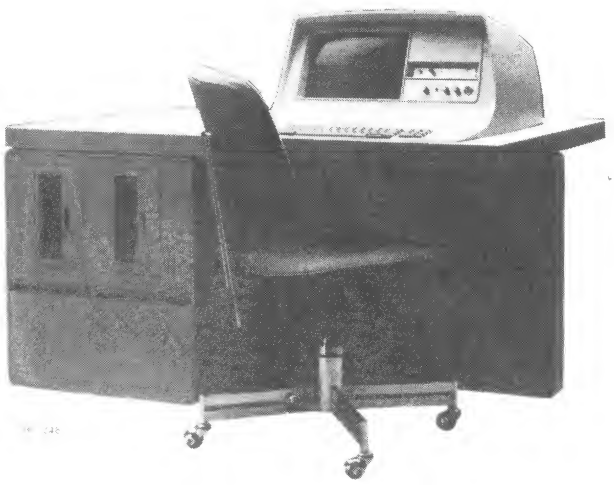
Vendor-Supplied Firmware, Software, and Diagnostics. Many intelligent display terminal systems today come equipped with vendor-supplied firmware (operating systems) and software (applications-type programs) to facilitate installation and implementation. With minicomputer-based systems this is almost obligatory on the vendor's part; with microprocessor-controlled terminals, however, it is discretionary. Emulation programs, utilities, report writers, and various compilers are offered to complement the terminal's hardware features and reduce program development costs. Diagnostics, on the other hand, are provided by the vendor to allow the user to monitor terminal performance, as well as pinpoint operating deficiencies.

SUMMARY

Selecting an intelligent alphanumeric display terminal is an exacting process that deserves the same consideration as any other major hardware acquisition. By following the guidelines set forth in this portfolio and seeking a terminal that possesses the features AUERBACH has enumerated, the prospective user will make his job that much easier.

APPLIED DIGITAL DATA SYSTEMS, INC. (ADDS)

System 70



OVERVIEW

Applied Digital Data Systems' (ADDS) System 70 is a microprocessor-based, display-oriented intelligent terminal system. It is a single-station system designed primarily for source data entry, and is preprogrammed for file manipulation and communications operations. ADDS has facilitated these operations by providing an English-like language that is designed to be used by office personnel for data entry and generating forms. ADDS markets the System 70 for use in a distributed processing network of businesses such as banks and insurance companies.

The System 70 uses an Intel 8080 microprocessor with 64K bytes of memory. The CRT displays 1,920 characters and has an additional line, a status line; the operator calls up files and forms by keying commands into the instruction field of the status line. The keyboard is a standard typewriter keyboard with a separate numeric pad and 24 function keys. One IBM 3740-compatible, 242,944-character diskette is standard; a second diskette with the same character capacity can be added. A communications interface, controlled by a second Intel 8080 microprocessor, is optional.

A range of line printers is available for use with the System 70. As an option, up to four System 70 terminals can share one printer via a printer pooler option. Printers available include a 30-cps matrix printer and 150- and 340-lpm belt printers.

ADDS has developed its own language for the System 70, the Terminal Command Language (TCL). The operator enters commands into the instruction field of the status line by spelling out the first few letters of the English-word command. Forms are generated either by an operator keying TCL commands via the keyboard or by a remote CPU operating through the communications interface. The operator also uses TCL when editing, copying, or updating files.

The System 70 is either EBCDIC or ASCII code-compatible; both are standard on the terminal. It operates in a half-duplex mode on switched or private lines. The System 70 is a binary synchronous communications terminal. Asynchronous communications are available via a modified control program stored in RAM. The System 70 can communicate as an IBM 3780 remote job entry (RJE) terminal to a host system.

Maintenance for the System 70 is handled by 78 offices of General Electric's Apparatus Service Business Division (ASBD).

Deliveries of the first ADDS System 70 were in August 1976.

COMPATIBILITY

The System 70 offers IBM 3780 compatibility at speeds of 2,000–9,600 baud with CRC transmission error corrections. It is capable of using any independent supplier modems for telecommunications.

At this time, Applied Digital Data Systems has not developed a growth path for the System 70.

PERFORMANCE AND COMPETITIVE POSITION

The System 70 offers intelligent capabilities in a terminal that is relatively easy to operate. Using Terminal Command Language (TCL) the operator calls up a preprogrammed form and enters data. This data can be stored temporarily for later transmission to a host or maintained at the local site on diskette. TCL is also used when the operator edits, copies, or updates data.

HEADQUARTERS

Applied Digital Data Systems, Inc
100 Marcus Boulevard
Hauppauge NY 11787
(516) 231-5400

Because of the large capacity of the System 70's CRT screen, there is less forms chaining and fewer operator waits and keystrokes. An additional feature of the CRT is the status line, a separate line at the bottom of the screen. The operator enters commands, calls up files and diskettes by keying instructions into the status line.

ADDS is targeting large businesses with the System 70; it is designed to operate in a distributed processing network, providing remote offices with intelligent data entry as well as local storage. ADDS sees its competitors as the Sycor 350 and Datapoint 1100. All three terminals (Sycor, Datapoint, and ADDS) are display-oriented, and have roughly comparable capabilities. The System 70 and Datapoint 1100 have maximum transmission speeds of 9,600 baud — twice as fast as the maximum speed of the Sycor 350. The ADDS 70 has a greater screen capacity than either the Datapoint 1100 and Sycor 350. Pricewise, the System 70 is lower than both systems.

One of the most attractive features of both the Datapoint 1100 and the Sycor 350 is the upward compatibility the vendors offer with their systems. At this time, ADDS does not provide a growth path for the System 70. An additional advantage the Datapoint 1100 and Sycor 350 have over the System 70 is the greater number of peripheral they are capable of attaching. The System 70 is capable of attaching only a printer, an additional diskette, and a communications interface.

USER REACTION

The user contacted was one of the first customers of the System 70; 500 terminals were ordered for use in a network system.

Systems House. This corporation is using the ADDS System 70 as part of a network system it is developing for a customer. Located in remote offices of the customer, The System 70 will be used to collect and store data locally. This data is, in turn, polled by Data General Novas.

The System 70 terminals have been in operation for approximately three months, but have been used by the system house's technical personnel. Eventually, non-technical office staff will be operating the terminals. Although TCL is not a general-purpose language, it has proved satisfactory in performing data entry and filing.

Singer, Sycor, Datapoint, and MSI terminals were also considered when the systems house was developing the network. The capabilities of these systems are comparable, but the price of the System 70 was attractively low, and an ADDS Consul 980 was already integrated into the network.

ADDS has provided prompt maintenance service and has proved very reliable in their deliveries.

Table 1. System 70: Specifications

Central Processor	
Microprocessor	Intel 8080
Main memory	64K
CRT Display	
Char. set (no. of characters)	128 ASCII
Max. char/line	80
Max. no. of lines	24
Keyboard	
Console layout	Std. typewriter; num. pad; cursor; func. controls
Code generated	ASCII
Peripherals	
Diskettes (Max. of two)	242,944 characters
Matrix printer	30 cps
Belt printer	340 lpm
Data Communications	
Line facility	Switched or private lines
Transmission code	EBCDIC and ASCII
Synchronization	Sync or async
Data rate (bps)	2,000–9,600 bps sync./ 300–9,600 bps async
Error control	CRC
Terminal emulation	IBM 3780
Software	
Program language	Terminal Command Language (TCL)

SYSTEM DESIGN

The ADDS System 70 comprises a microprocessor with 64K bytes of memory; a 1,920-character CRT display screen; a standard typewriter keyboard with a separate numeric pad and 24 separate function keys; and one IBM 3740-compatible diskette. An optional communications interface can be attached as well as a range of impact printers. The system microprocessor is an Intel 8080.

During installation of the system, various switches can be set up. These switches are located on the system or communications interface PC boards. Included among these switches are: an ASCII/EBCDIC switch, and auto-answer switch, an auto-dial switch that requires a Bell 801 or equivalent auto-dial units, and a terminal ID switch.

It is also possible to attach an additional CRT or teletype (and/or front end bus) to the system by means of a Customer Engineering (CE) card. The teletype is able to access the microprocessors for purposes of program diagnostics and system maintenance.

CRT. The CRT screen measures 14" diagonally and is divided into two sections — a display area and a status line. The display area is 24 lines of 80 characters (a total of 1,920 characters); this entire area can be used for forms as well as data. The character set is ASCII (all 128 characters) and uses a 7 x 9 dot-matrix display pattern. These characters are displayed in black on a light background, but a switch to reverse this pattern is available.

Status Line. The status line is divided into nine fields separated by null characters. These fields are: instruction, name, mode, form, identification, cursor, active

diskette, diskette pointer, and status fields. The operator, by keying instructions into the status line can transfer data between the physical devices (diskette, printer, CRT, communication interface) of the System 70.

The first field of the status line is the instruction field. Using the Terminal Command Language (TCL), the operator keys terminal instructions into this field. It can display a total of 25 characters. The name field, made up of six characters, informs the operator of the open data set on both diskettes. The mode field is one character composed of three letters: a *D* for data entry mode, a *V* for verify mode, and an *F* for forms generation mode.

The form identification field is also filled in automatically by the system and identifies the form displayed on the screen as well as those that precede and follow. It is composed of three characters. The cursor field, 2 characters, gives the horizontal cursor address. The active diskette field displays either a 1 or a 2, depending on which diskette has been addressed.

The final field, the status field, displays in 10 characters the status of the system or any error conditions that may exist. An error is indicated by a short audible signal as well as by a blinking error message in the status field.

Keyboard. The keyboard is composed of two basic sets of keys — alphanumeric keys and function keys. The alphanumeric keys are laid out in standard typewriter format and ten-key adding machine format; their main function is data entry. The programmed function keys are used to edit data, control peripherals, effect cursor movement, initiate transmission and printing, and execute instructions. The keyboard is divided into three functional sections, each of which is color coded to separate the data entry keys from the editing and control keys. Standard with the keyboard is an audible key-click, keyboard security lock, and an audio tone for operator errors.

The keyboard-generated codes are stored in a 1,920-character CRT buffer; a video generator then displays the characters on a CRT screen. The communications interface, the diskette, or the printer buffer (132 characters) can also receive data stored in the CRT buffer. If data is transferred from the diskette to either the printer buffer or the communications interface, it must first move through the CRT buffer.

Diskette. The diskette for the System 70 is IBM 3740-compatible and has a total data storage capacity of 242,944 characters. A second diskette that can be used for data copying is available as an option. Data is recorded in EBCDIC code. Data entry from the keyboard to the diskette can be performed simultaneously with the printing of data from the communications interface. All data is transferred between the system and the diskette storage through the use of system-generated forms.

PERIPHERALS

At this time, the ADDS System 70 attaches a limited number of peripherals.

Diskettes. A floppy disc of 242,944 characters is standard; an additional floppy disc of the same storage capacity is optional. The second diskette can be used for data manipulation and diskette copying in addition to data storage. All data transfer to or from the diskette is done through the use of forms. These diskettes are IBM 3740-compatible, and have automatic read/write error checking.

Printers. A range of impact printers can be attached to the System 70 via an optional communication interface. The printers now available are: a 30-cps matrix printer with 80 or 132 print position, and 150- and 340-lpm belt printers with 132-column print line.

A 2,000-character print buffer is associated with the printer interface; data is transferred from the print buffer a line at a time to a line buffer located in the printer. The printer can be used to provide a hard copy of data displayed on the CRT; data received directly from the communication interface; or data received directly from the diskette.

Also available is a printer pooler that allows a maximum of four terminals (located within 50 feet of each other) to share one printer. While printing is taking place, all terminals are locked out from initiating a second print operation.

DATA COMMUNICATIONS

The ADDS System operates in a half-duplex mode over switched or private lines. Either EBCDIC or ASCII transmission codes are offered.

The optional communication interface is independently controlled by a second Intel 8080 microprocessor; bi sync communications rates of up to 9,600 baud are possible. IBM 3780 compatible bi-sync communications are available at speeds of 2,000 to 9,600 baud with CRC transmission error correction procedures. Point-to-point and dial-up capability are offered.

The System 70 can automatically answer an incoming call on switched network. In addition, the system can recognize and carry out a disconnect command from a remote CPU or, when a connection is not maintained, disconnect on its own.

When the System 70 operates in a local mode, it can receive and acknowledge data from the mainframe, but is not able to transfer data.

An asynchronous communications option is available for the ADDS 70 via a modified control program. Transmission speed options are 300, 600, 1,200, 2,400, and 9,600 bps.

Data can be transmitted from the System 70 to a host mainframe in three ways. By depressing the special function ENTER key while the system is on-line, data on the display screen can be transmitted directly to the host system. Data stored on diskette or operation instructions can be transferred via keyboard commands.

SOFTWARE

ADDS has developed its own language, Terminal Command Language (TCL), for operator to system communication. TCL uses English-like statements that can be condensed to three letter mneumonics for operator convenience. Via these three letter commands, the operator is able to:

- Control data entry functions.
- Create screen formats.
- Initiate printing.
- Copy data from diskette to diskette.
- Transmit data to a host.

Using TCL, it is possible for the user to generate forms from the system keyboard or down-line load them from a remote CPU. Forms are stored on the diskette (in a Forms Data Set) and are recalled by depressing special function keys.

MAINTENANCE

ADDS System 70 equipment is installed and maintained by Applied Digital Data Systems, Inc., through 78 offices of the Apparatus Service Business Division (ASBD) of General Electric. An independent leasing company, ADDS Leasing Corporation, handles the 36-month leases for System 70 equipment.

PRICE DATA

Model Number	Description	Purchase Price (Maint. not Included) $	Monthly Rental (Maint. not Included) $	Monthly Maintenance $
	Basic System 70 with one diskette drive	7,295	178	40
7010	Communications Interface	700	20	10
7015	Auto-Call Option (initiates automatic telephone dialing)	800	26	10
7020	Second Diskette Drive	995	30	15
7030	Printer Interface	895	28	10
7210	Matrix Printer: 30 characters per second	3,000	99	25
7220	Belt Printer: 150 lines per minute	4,600	150	50
7230	Belt Printer: 340 lines per minute	6,600	220	50
7233	Printer Pooler Mounted in Pedestal of Printer	750	24	10

BEEHIVE INTERNATIONAL

B500 Computer Terminal

OVERVIEW

Beehive International's B500 Computer Terminal is a tabletop, microprocessor-based intelligent display unit. A 106-key keyboard can be connected and operated, either attached to or detached from the display unit.

The unit will support a full- or half-duplex, asynchronous or synchronous communications line operating at up to 19,200 bps, a printer attachment, and a peripheral attachment. All electrical interfaces conform to the RS-232C standard. The B500 employs an Intel 8080A microprocessor which has a cycle time ranging from 0.15 to 1.5 microseconds.

The basic unit contains 4K bytes of MOS RAM for display memory and 2K bytes of ROM for program memory. The 2K ROM can be optionally expanded to 8K bytes in 2K increments; or the ROM can be replaced by up to 4K bytes of PROM, in 1K byte increments. Optionally, the unit supports three increment modules of either 4K bytes or 16K bytes of RAM for a total additional RAM of 48K bytes.

A 12-inch (diagonally measured) CRT is standard with a 128-character set for 25 lines of display and 80 characters per line. A 15-inch screen is optional, as are an additional 128 programmed characters. Each 128-character set requires a 2K byte ROM. Scrolling up to 50 lines, full cursor control and up to eight programmed keyboard function keys are provided.

The recently introduced B550, an enhanced version of the B500, is available with up to 7K PROM, compared to a maximum of 4K PROM offered with the B500. The B550 also offers line send compatibility and time shared compatibility. Data entry features are enhanced through forms generated alphanumeric, alpha, numeric, must fill, and total fill field attributes. It has the same keyboard, display, and processor as the B500.

Beehive currently manufactures and distributes a full line of display terminals, ranging from the minimum capability B100 and to the B800 video terminal computer system. Although Beehive has no direct sales outside the United States, the terminals are sold in Europe and Asia by OEMs and distributors. Beehive has been marketing the B500 Computer Terminal since 1976. To date, over 1,000 B500 terminals have been delivered.

PERFORMANCE AND COMPETITIVE POSITION

The B500 is geared for the single-station display/keyboard programmable terminal requirement. The unit is especially suited for installations where the mass storage unit and the printer either already exist or where they have already been selected. Therefore, the B500 lends itself to OEM sales.

The Lear-Siegler VDP-400 is competitively priced against the B500. The VDP-400, however, restricts transmission speeds to 9,600 bps, compared with the B500's transmission speed of 19,200 bps; given the limitations of voicegrade lines, however, this advantage comes into play only in a small number of situations. Also, the VDP-400 supports 32K bytes of optional RAM as opposed to the B500's 48K bytes.

The Hewlett-Packard 2645A competes with the B500 and offers magnetic tape cartridge units.

CONFIGURATION AND OPERATION

The Beehive B500 computer terminal consists of two basic units: a detachable keyboard and a CRT display. The 106-key keyboard provides eight special function keys, additional editing capabilities, program entry keys, and scrolling keys. The keyboard also provides N-key rollover and auto-repeat features as well as an 11-key numeric keypad. A programmable keyboard, offered as an option, allows the user to specify keycaps, character fonts, or special software. Blank keys are also available for users who may want to engrave them for a specific character set.

A 12-inch CRT (15-inch optional) displays 25 lines of 80 characters generated on a 7 x 8 dot matrix. Capacity of the display memory is 4,000 characters, half of which can be displayed at one time. The Beehive B500 displays messages composed from an upper- and lowercase, 128-character ASCII set. In addition, a user-specified set of

128 display symbols is available as an option. A second set of 128 displayable ASCII or user programmable symbols is optionally available on the 106-key model.

Data is transmitted in character or block mode. As it is entered each character is sent in character mode. In block mode, however, entered data is stored in memory to be transmitted at a later time. In this mode, a message or page can also be transmitted. The B500 can also transmit data in the Pseudo Poll mode. In this mode, the terminal requests to send information to the host and then waits to receive a clear-to-transmit signal.

Display features include reversed and blinking video, as well as half intensity video. Full cursor controls are provided as standard. In addition, cursor sensing and addressing are featured. Scrolling is accomplished within the limits of a two-page memory (50 lines). Editing capabilities include character and line insertion and deletion. The Format mode provides for tabulation and format protection between unprotected fields. Only unprotected fields can be erased in the Format mode. Erase functions include clearing from the cursor to the end of the line, clearing from the cursor to the end of the memory, or clearing the entire memory. An audible alarm sounds at the 72nd position on a line. See Table 1 for specifications.

COMMUNICATIONS INTERFACE

Four connector ports are provided in the rear of the display unit. One port is reserved for the attachment of a keyboard. A second port, the I/O port, supports a communications line operating at up to 19,200 bps in either full- or half-duplex modes. A third port supports another communications line operating at up to 19,200 bps for output transmission only. This port is intended for attachment of a printer. The fourth port, the auxiliary port, operates at either 19,200 bps or, for parallel transfer, at 4,000 characters per second. This port is intended for attachment of a peripheral device such as a paper tape reader, cassette unit, or a floppy disk. All connectors conform to the RS-232C interface standard.

SOFTWARE

User programs can be written for the optional RAM in any Intel 8080-supported language. Since an 8080 processor is utilized, any Intel 8080 code can operate with the B500, whether 8080 FORTRAN or BASIC is used. The assembled programs can be downloaded from the host or can be loaded from attached mass storage. A debug monitor (DEMON) available optionally at extra cost, provides the capability to debug programs at the terminal. CHARGEN, a program to support a customized character set generator, in addition to the standard 128 ASCII character set, is offered at additional cost.

MAINTENANCE

The B500 is warranted against defects in materials or workmanship for one year from the date of purchase. Maintenance is handled under a national contract by Sorbus, Inc, a third-party service company. The normal maintenance contract covers all parts and on-site labor for nine consecutive working hours, five days a week. Extended maintenance coverage is available on request.

Table 1. Beehive B500 Computer Terminal: Specifications

Microprocessor	
Model	Intel 8080
Cycle Speed (μsec)	0.5-1.5
Maximum ROM (bytes)	8K
Maximum PROM (bytes)	4K
Display RAM (bytes)	4K
Maximum Addl RAM (bytes)	48K
Display Unit	
Screen Size (char)	2,000
Char per Line	80
Lines per Display	25
Paging Capacity	Yes
Character Set (std)	128 ASCII
Character Set (opt total)	256
Character Generation	7 x 8 dot matrix
Standard Screen Size	12 inches
Editing/Formatting	
Horizontal Tab	Yes
Character Typeover	Yes
Character Insert/Delete	Yes
Line Insert/Delete	Yes
Split Screen	Yes
Partial Transmit	Yes
Scrolling	Yes
Data Transmission	
Line Facility	Voicegrade
Line Speed	75-19.2K bps
Line Mode	HDX/FDX
Line Code	ASCII
Synchronization	Async
Interface	RS-232C
Error Control	
Detection	Parity
Correction	Manual Retransmission
Features	
Mass Storage	RS-232C interface provided
Printer	RS-232C interface provided
Reverse Video	Yes
Integral Modem	No
Blinking Cursor	Yes
Polling/Addressing	No
Numeric Cluster	Yes
Switchable Speeds	Yes
Detachable Keyboard	Yes
Audible Alarm	Yes
Compatibility	
Computer System	Any via switched comm line
Terminal Emulated	TTY 33/35
Bell System Data Set	103
First Delivery	1976

Beehive maintains field service depots throughout the world. Users electing not to purchase on-site maintenance may ship defective units to any of these facilities for repair at no cost while they are still under warranty or for a fee after the warranty expires.

PRICE DATA

Purchase prices for the B500 terminal follow. Although Beehive does not offer the terminal on a lease basis, the company will negotiate third-party leases. Quantity discounts are available.

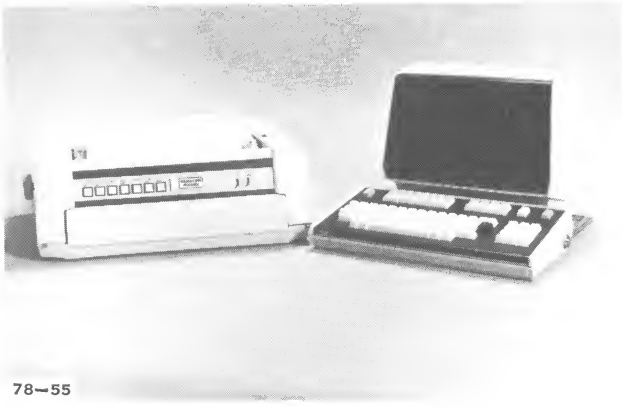
Description	Purchase Price $
B500 Terminal	
Terminal without Keyboard	2,650
Terminal without Keyboard, 7-light indicator panel	2,750
Upper-Level Model	
106-key keyboard	2,880
106-key keyboard, 8 program function keys	2,930
106-key keyboard, 2-light indicator panel	2,930
106-key keyboard, 8 program function keys, 2-light indicator panel*	2,980
B550 Terminal	
Terminal without keyboard	2,700
Terminal without keyboard, 7-light indicator panel	2,800
Upper-Level Model	
106-key keyboard	2,930
106-key keyboard, 8 program function keys	2,980
106-key keyboard, 2-light indicator panel	2,980
106-key keyboard, 8 program function keys, 2-light indicator panel*	3,030
Options	
Character Generator #1	
ASCII	NC
Programmable	90
Character Generator #2	
ASCII	50
Programmable	90
Program Memory (RAM)**	
4K bytes	175
8K bytes	350
12K bytes	525
16K bytes	750
32K bytes	1,500
48K bytes	2,250
PROM (1K byte)	163
DEMON (Debug Monitor)	
PROM	400
Paper Tape	200

*This model will not support a second generator character, extra RAM memory options, or an auxiliary I/O port.

**A minimum of 4K RAM is needed to use function key features or DEMON software package.

BUNKER RAMO CORP

System 90 Intelligent Terminal Display System



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OVERVIEW

The System 90 is a multi-station, intelligent terminal display system designed by Bunker Ramo for distributed processing applications. Originally introduced by Bunker Ramo in 1975 as the Bank Control System 90, the System 90 employs the same functional components but features enhanced software and communications capabilities. Built around a powerful Programmable Control Unit (PCU), the System 90 can be adapted to the operational requirements of administrative as well as financial users.

The System 90 Programmable Control Unit (PCU) is a minicomputer with memory expandable from 16K to 256K bytes in increments of 8K or 16K-byte modules. The PCU provides processing logic, display refresh, device control, memory, and communications interface functions for all display and peripheral equipment. The system's other principal elements include CRT display terminals with 960 and 1920 character screen capacities, 30-cps and 120-cps serial impact printers; and an auxiliary dual diskette storage unit with 250K bytes of storage per diskette.

The CRT display terminals are equipped with separate typewriter-style keyboards and are supported by the PCU. Each unit features system and terminal status indicator characters, protected fields for form completion applications, local print control, and a security keylock. A smaller CRT display terminal with 240 and 480 character screen capacities and a customized keyboard is available as an option.

Designed for use in a real-time, on-line multiterminal environment, the System 90 can emulate the IBM 3270 or Burroughs TD-700/800/820 terminal series. In addition to these emulation programs, System 90 software includes a Basic Operating System, Program Support Package, and Utility Programs which permit users to program more sophisticated applications.

Bunker Ramo is a major manufacturer and leading supplier of CRT-based intelligent terminal systems for the financial industry.

DATA COMMUNICATIONS

All System 90 communications, including IBM 3270-compatible operations, employ the PCU Communications Interface. This interface operates asynchronously or synchronously in half- or full-duplex modes, at speeds ranging from 110 to 9600 bps. Both ASCII and EBCDIC transmission codes are accommodated, and ASCII, IBM BSC, IBM SDLC, and Burroughs synchronous protocols are supported. The PCU Communications Interface also provides an automatic answerback feature for diagnostic capabilities. Multiple communications interfaces are available to handle the host processor connection and multidropped terminals concurrently.

Internal and external System 90 modems are available for a wide range of serial communications at rates of 1,200 bps for asynchronous lines and 2400 to 4800 bps for synchronous lines. These modems do not require line conditioning. The System 90 is equipped with an RS-232C serial interface for connection to an external modem.

In the event of telephone circuit failure, an integral PCU dial-up Fallback Adapter provides a means of transferring the host-to-PCU data communication path from the inoperative leased line to dial-up facilities.

COMPATIBILITY

The System 90 is compatible in terms of code and communications protocol with any IBM or Burroughs host computer system operating under Binary Synchronous Control (BSC), Synchronous Data Link Control (SDLC), or Burroughs Synchronous protocols.

HEADQUARTERS
Bunker Ramo Corporation
Information Systems Division
Trumbull Industrial Park
Trumbull, CT 06609
(203) 377-4141

Bunker Ramo software emulators enable the System 90 to function as an IBM 3270, Burroughs TD-700/800, or Burroughs TD-820 display terminal system. The software emulators utilize complete selection commands, including read/write commands and all orders such as set buffer address, insert cursor, and program tab. All IBM 3270 attribute characters for screen formatting are fully supported. Video attributes of nondisplay, normal intensity, and blinking are available on all displays.

PERFORMANCE AND COMPETITIVE POSITION

Bunker Ramo, a recognized leader in financial industry terminal systems, designed the Bank Control System 90 to meet the needs of commercial banks. After a three-year pilot installation, the BCS 90 was offered to the banking industry in 1975. The system proved so successful in financial applications that Bunker Ramo decided to add more sophisticated software and to market it as the System 90, a complete distributed processing system.

System 90 is designed for ease of operation. Information retrieval, data entry, reporting and updating functions are processed on-line in real-time. With programmed data entry and file maintenance functions, errors are greatly reduced. The System 90 CRT display terminal leads the operator through an unfamiliar transaction by presenting on the screen a format that "asks" the operator for a response.

From a competitive standpoint, the System 90 is comparable to the Four-Phase IV/70 and the Incoterm SPD-20/20 intelligent terminal display systems. The Four-Phase IV/70 is also a multi-station, intelligent terminal system capable of emulating IBM 2780/3780 terminal systems. Featuring a 48K-byte processor, 2.5M-byte disk, 300 to 1800 lpm line printers, and 1152/1920 character CRTs, the Four-Phase system performs a variety of data entry and communications functions. Average monthly lease charge is $1,140 for atypical Model IV/70.

The Incoterm SPD-20/20 is a clustered, intelligent display terminal system which employs an 8K-byte processor (expandable to 32K bytes), a unique 7 x 10 dot matrix display with 960/1920 characters, and support for up to 64 devices. Since the Bunker Ramo System 90 is a proven on-line business system compatible with IBM and Burroughs host systems and with complete software facilities, the System 90 is competitive.

USER REACTION

AUERBACH interviewed the original users of both the Bank Control System 90 and the System 90.

The first user, a large California bank, installed a prototype of the Bank Control System 90 in 1974 after evaluating more than twenty different systems. The system is used primarily for memo posting and balance file maintenance for DDA, savings, and installment loans. Inquiries at teller and back-office terminals are facilitated by 2,000 Bunker Ramo mini-display CRT terminals and 1,500 large-screen CRT units. Bunker Ramo's BANKTRAN software was augmented to a large extent by the bank's own applications software.

According to this bank, the system was selected not only for its cost effectiveness but also because of Bunker Ramo's reputation.

The second user contacted, one of the largest insurance companies in the world, is using the System 90 extensively for the on-line processing of medical and dental policyholder claims. The officer in charge of the automated claims system explained that the system was implemented to prepare for the possibility of national health insurance as well as to reduce a rapidly expanding claims workload.

Proposals were solicited from over 40 terminal vendors and were received from 18 to 20. When the field was narrowed to four systems, each was installed and tested for six months.

The pilot office now has about 60 Bunker Ramo (BR) Model 90/17 terminals and associated BR 90/97 printers which operate at 120 characters per second. The terminals are on-line with the IBM 370/168 host system located at the company's headquarters office two miles away over leased lines operating at 4,800 bits per second. Bell 208 data sets are used for modulation and demodulation.

The System 90 has enabled the company to maintain efficient and uniform policy claims processing and good turnaround time. In the future, other branch offices will have from 16 to 60 Bunker Ramo terminals installed, depending on the volume of claims.

No operational or maintenance problems of any consequence were encountered by this user.

SYSTEM DESIGN

The System 90 features three functional components: a Programmable Control Unit (PCU), a CRT display terminal, and a typewriter-style keyboard.

Programmable Control Unit

The PCU is a Bunker Ramo-designed minicomputer with 16K bytes of memory expandable to 256K bytes in increments of 8K- or 16K-byte modules. It is organized around a single I/O bus with a throughput capacity of 1.2 million characters-per-second and an address capacity of 256 devices. All nondisplay components, including the processor, up to 256K bytes of memory, and peripheral device interfaces, communicate with each

other and transfer data via the bus. Display devices are refreshed directly from main memory in order to isolate the high memory access rate of the CRTs from the rest of the system.

The PCU is packaged in a small chassis, approximately 16 inches high and 24 inches deep, suitable either for placing in a standard 19-inch rack mounting or for freestanding tabletop use. The chassis contains an operator's panel, a power supply, a backplane for up to 15 functional circuit boards, and connectors for the CRT/keyboard and other I/O device connections. A single chassis of this size is adequate for most branch configurations. The most complex systems (which include up to 32 CRTs, up to 262,144 bytes of memory, floppy disk units, or other rack-mounted devices) require no more than two chassis stacked in a 19-inch rack.

The PCU processor uses a microprogram-driven instruction set, resembling that of a general-purpose minicomputer and optimized for character (byte) processing. Instruction formats are contained in one or more 16-bit words (two bytes), with the number of words dependent upon the instruction. Arithmetic/logical operations are normally performed on each eight bits or on one byte. Memory addressing is by byte; and 16-bit registers are used as addresses or addresses stored in memory, allowing direct addressing of the full 64K-byte storage capacity of the PCU. Additional segments of memory are accessed via a Selection command. Once selected, any position within that segment can then be addressed directly. Average instruction time for a routine mix is approximately 4.5 microseconds.

An optional single or dual flexible disk cartridge drive is available for off-line operation, local data storage, and program loading with the PCU. An optional Battery Pack maintains the contents of the PCU's main memory for at least half an hour in the event of a power failure.

CRT Display Terminal

The System 90 CRT display is available in a variety of configurations: the standard Model 90/17, a 12-inch CRT with 1,920 characters displayed in twenty-four 80-character lines; Model 90/15, a 9-inch CRT with 960 characters displayed in twenty-four 40-character lines or in twelve 80-character lines; and a Model 90/15 with 480 characters displayed in twelve 40-character lines. The standard System 90 character set consists of 96 ASCII symbols (including upper and lower case alphanumeric and special characters). Each symbol is displayed in a green 5 x 7 dot matrix.

Keyboard

CRT display Models 90/17 and 90/15 are equipped with a typewriter-style detachable keyboard. The keyboard contains a 32-key shiftable function cluster, a 10-key numeric pad, and a security keylock to protect against unauthorized terminal use. The keyboard generates any of 128 ASCII character codes.

PERIPHERALS

Bunker Ramo offers a wide variety of peripheral devices that can be configured with the System 90.

Printers

For applications that require generation of printed hard-copy at branch offices, administrative serial printers are available for use with the PCU. The two teleprinters supported are the GE TermiNet models rated at 30 and 120 characters per second. Both are impact devices with multicopy capability.

The PCU printer control program allows printers to operate in a Processor Printout mode, Display Printout mode, and Processor/Display Printout mode. The Processor Printout lists data from the central processor via addressable storage assigned exclusively to the printer. The Display Printout prints data upon terminal operator command from storage assigned to a CRT display station. The Processor/Display Printout prints data from the central processor via the storage assigned to a CRT display station.

Diskette Storage

Single or dual diskette drives are available with 250K bytes of storage per disk. The diskette (a Shugart SA 900), with an average rotational delay of 83 milliseconds has a rotational speed of 360 rpm. The data transfer rate is 31,250 bytes per second.

Utilized for program storage, the diskette storage unit provides backup for loading the operating system and applications software. Storage is also available for off-line data capture.

Mini-Display Terminal

A mini-display terminal which displays 240 or 480 characters on a five-inch CRT (with a block alphanumeric keyboard) is available for data entry applications.

Internal and External Modems

Synchronous modems designed to operate at 2,400 bps without any line conditioning are available as an option.

Bunker Ramo System 90 specifications appear in Table 1.

SOFTWARE

Operational and applications software for the Program Control Unit (PCU) and utility programs for the

Table 1. Bunker Ramo System 90: Specifications

Description	System 90
Control Processor	Bunker Ramo Minicomputer
Memory Type	MOS/RAM
Memory Size (bytes)	256K
Word Size (bits)	16
Program Entry	Communications or Diskette
Arithmetic Operations	Yes
Maximum I/O Devices	32
Utilities	Assemblers/Loaders, Diagnostics
Keyboard	
No. of Char	96
Char Set	ASCII
Function Keys	32
Security Lock	Software
Numeric Pad	10 Key
Display Unit	
Screen Size (char)	240, 480, 960, 1920
Characters per Line	20, 40, 80
Lines per Display	12, 24
Character Set	96 ASCII
Character Generation	5 x 7 dot matrix
Peripherals	
Diskette Drive	Single/Dual
Storage Capacity (Kb)	256
Terminal Printer	
Method	Belt
Speed (cps)	30, 120
Max Print Line	118
Data Transmission	
Line Facility	Voicegrade
Line Protocol	Bisync, SDLC, BDLC
Line Speed (bps)	110 to 9600
Line Mode	HDX, FDX
Line Code	ASCII, EBCDIC
Synchronization	Async, Sync
Interface	RS-232C
Compatibility	
Computer System	IBM S/360 & S/370, Burroughs
Terminals Emulated	IBM 3270, Burroughs TD 700/800/820
Bell Data Set	201 A/B, 208A
First Delivery	1976

host computer system are provided by Bunker Ramo with the System 90. No changes to existing hardware or software are required. System 90 software consists of the Basic Operating System (BOS), the 3270 Emulation Package, the Program Support Package (PSP), and Utility Programs.

The BOS is a real-time, multiprogrammed operating system that can support up to 32 users simultaneously and their individual programs concurrently. BOS consists of Job Management, I/O Management, Resource Management, and Disk Interface modules. Job Management controls the concurrent execution of jobs and dynamically updates job priority. I/O Management coordinates the processing of data transfer requests between terminal devices. Resource Management allocates hardware resources to the highest priority job in the queue. Disk Interface modules provide file management support for the System 90.

The IBM 3270 Emulator Package includes a complete set of commands (read, write, copy, and erase) and general and specific polls. Standard display and printer orders such as set buffer address, insert cursor, program tab, and form feed are also supported.

The Program Support Package (PSP) enables users to configure, assemble, store, and link standard System 90 and their own application software and to down-line load it via the communications line into the PCU. The PSP Cross-Assembler generates an application object code which is executable on the PCU. The Program Support Package is compiled via the host computer system's FORTRAN compiler and library facility. The System 90 source program, user-created formats, parameter tables, and application program modules are stored at the host.

System 90 Utility Programs feature System/Device Initialization routines, a Real-Time Clock facility, a Program Loader, and a Dump Program. Except for the real-time clock facility, all System 90 utilities are run when the PCU is not processing transactions.

MAINTENANCE

Bunker Ramo maintains a nationwide customer engineering organization which operates from 75 service locations in six major regions. Each region has its own manager and central dispatch facility. Maintenance contracts available from Bunker Ramo provide for prime shift and extended shift coverage.

PRICE DATA

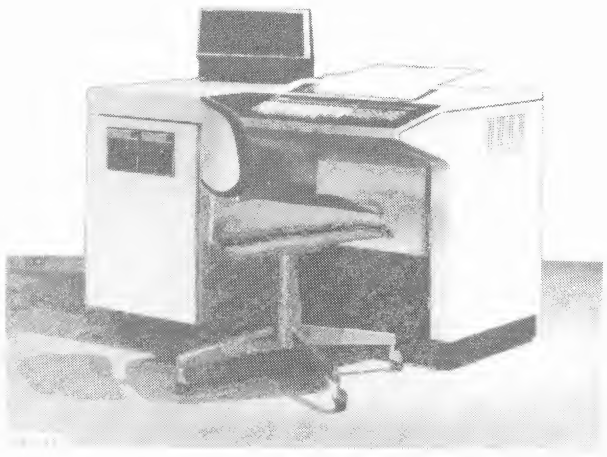
The Bunker Ramo System 90 is available on a purchase only basis with maintenance quoted separately. Quantity discounts are available. Bunker Ramo is in the process of developing a leasing program.

Bunker Ramo prefers to quote prices on representative system configurations rather than on individual system components. The purchase prices for typical systems are listed below.

Description	Purchase Price $ (Maint. not Incl.)
System 90 with 32K bytes of memory, 8 keyboard/display stations, no diskette storage, and no printers	
With 480- or 960-character display stations	23,415
With 1920-character display stations	23,715
System 90 with 48K bytes of memory, 16-1920 character keyboard/display stations, and no diskette storage	
With 3 additional 30 cps printers	53,755
With 3 additional 120 cps printers	56,380
First Diskette Drive (includes controller for up to 4 drives)	3,790
Each Additional Diskette Drive	1,470
Belt Printer, 30 cps	3.975
Belt Printer, 120 cps	4,850

BURROUGHS CORP.

TC Series Terminal Computers



OVERVIEW

Burroughs TC Series Terminal Computers are a family of intelligent terminals designed for batch and on-line data communications and local processing. All TC terminals feature the well-known Burroughs integral keyboard and a console printer for operator/system communication. As one of the original intelligent terminals, the TC Series supports programming capabilities for device and communications line control, data formatting, and data validations.

Externally, all current TC models resemble the original TC 500 terminals, which have enjoyed great success since their introduction to the U.S. market in 1968 (originally offered on the British market in 1967). Over the years, Burroughs has introduced a steady stream of new TC models to take advantage of newer technology and to pass improved price/performance on to its users. Currently, the most active members of the Series are the TC 3000 and TC 5000 models; however the TC 500 and 700 models are still to be found.

Late in 1972, Burroughs announced the TC 3500 Series, the first of a microsecond machine cycle class of terminal with enhanced transmission speeds. The TC 3500 line operated with a 3-microsecond machine cycle time and was capable of transmission up to 9,600 baud. More recently, Burroughs has announced the TC 3600, 3800, and 3900 models, which offer faster (1.5-microsecond) memory cycle times and improved printing speeds (30, 60, or 90 cps).

In 1975, Burroughs announced the TC 5000 Series as the latest in its line of intelligent terminals; these machines have an increased processor speed (1 microsecond).

The TC 3000 and 5000 Series terminals have all been designed for on-line data communications networks or for batch telecommunication of locally entered transaction data. All terminals are programmable in COBOL and compatibility is maintained at the program level among the various models of the TC family. All terminals are capable of asynchronous or synchronous (up to 9,600 bps) transmission to and from remote computers or other TC terminals; the TC 5000 models support the new Burroughs Data Link Control (BDLC) in addition to IBM 2260, 2780, 2740, and 3270 communications protocols.

The specifications of the active members of the TC Series are shown in Table 1.

COMPATIBILITY

The TC terminals can communicate with B 500 to B 7700 computers and the new Burroughs B 800 computer line, as well as other TC terminals. Communications with non-Burroughs machines is provided by a number of available emulators, including the IBM 2260, 2740-II, 3270, and IBM bi sync.

Programming compatibility is also an important feature of the TC line. Two programming languages are supported for TC terminals: COBOL and Assembly. Either language may be assembled on any large Burroughs computer and subsequently run on a TC terminal. Assembly language programs may also be prepared directly on certain TC terminal models. With the introduction of the TC 5000 Series, Burroughs has developed a more efficient version of its Assembly language, but has maintained support of the older Assembly language as well.

All programs written for older TC terminal systems are upward compatible with the newer models of the series. Burroughs recommends that TC programming be done in COBOL, so that programs written for a particular model may make use of performance improvements of future terminals. The TC COBOL compiler, which runs on a B 2700 or larger computer, will create programs for any TC terminal model.

HEADQUARTERS

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Table 1. Burroughs TC Series: System Specifications

	TC 500, TC 700	TC 3000	TC 5000
PROCESSOR			
User Memory (bytes)	500-3,300	4-51K	4-28K
Cycle Time (microsec)	5,000	1.5	1.0
Program Languages	COBOL, Assembly	COBOL, Assembly	COBOL, Assembly
No. of I/O Ports	1	8	3
KEYBOARD			
Layout	Typewriter, numeric pad, function keys	Typewriter, numeric pad	Typewriter, numeric pad, function keys
Code Set	ASCII	ASCII	ASCII
CONSOLE PRINTER			
Char Set (char)	64	64	64
Char/Line	150	150	150
Speed (cps)	20	30, 60, 90	60
PERIPHERALS			
Card Reader (cpm)	200	200, 300	No
Card Punch (cpm)	40	60	No
Paper Tape Reader (cps)	25	25	No
Paper Tape Punch (cps)	40	40	No
Line Printer (lpm)	80 to 250	80 to 250	80-250
Magnetic Tape (bpi)	800	800	No
Cassette Unit	Yes	Yes	Yes
Self-Scan Display (256 ch)	No	Yes	Yes
COMMUNICATIONS			
Line Facility	Voice, switched, private	Voice, switched, private	Voice, switched, private
Synchronization	Async	Sync/Async	Sync/async
Transmission Speed (bps)	150-1,800	75-1,800 async 2,000-9,600 sync	75-1,800 async 2,400-4,800 sync 1,200-9,600 direct
COMPATIBILITY			
Computer System	All Burroughs mainframes	All Burroughs mainframes	All Burroughs mainframes
Terminal Emulation	IBM 2260	IBM 2260, 2780 2740-II, 3270	IBM 2260, 2780, 2740-II, 3270

PERFORMANCE AND COMPETITIVE POSITION

The Burroughs TC terminals look very unlike the CRT-oriented systems that populate the current intelligent terminal marketplace. The TC Series most closely resemble an accounting machine; in fact, for some of the models of the Series there are corresponding models (with the exception of data communications firmware) among the Burroughs L Series of accounting/small business computers.

The TC's accounting machine features include a split platen forms handler, dual or single pin feed, and electronic keyboard, as well as COBOL programming capabilities. These features separate the Burroughs terminals from their counterparts offered by competitive mainframers. With the exception of NCR 299, 399, and 499, all the other mainframers retain central site control over intelligent terminal functions. The Burroughs TC models, however, can perform independent local processing and data communications without host intervention.

While maintaining system flexibility, Burroughs has, over the years, continually upgraded its offerings to reflect the latest in new technology. The original TC 500, for example, had a 5-millisecond cycle time and under 4K bytes of user memory; the newest TC 5000 Series operates with a 1-microsecond cycle time, allows up to 28K bytes of user memory, and offers a 60 cps console printer.

The TC 3000 and TC 5000 machines, the principal active members of the product line, differ from each other in their orientation. The TC 3000 is considerably more "system-like" than the TC 5000, that is, substantial system configurations may be constructed around its eight I/O ports by selecting appropriate peripherals — magnetic tape, punched card, cassette, or paper tape equipment.

The TC 5000 is a simpler class of intelligent terminal, with fewer user options available; no provisions are made for the attachment of the variety of peripherals available on the TC 3000 Series. While the TC 5114 and 5115 were originally offered as TC systems with diskette storage facilities, Burroughs has dropped them from the line to avoid competing with the Burroughs B 80 small business system.

A well-known and well-liked feature of the TC Series is its group of 16 program select keys. Key functions are assigned by the stored program and can be reassigned during program execution. Any combination of keys can be enabled by instruction. A row of indicator lights, positioned above the keys, alerts the operator to the enabled keys. After entering data via the keyboard, the operator can depress the program select key corresponding to

the identity of the data field entered; the keyboard instruction is terminated and execution of the appropriate program subroutine is initiated. This is implemented via a table in memory containing one instruction for each program select key.

When operating with a remote computer, all TC transmission and reception is under control of the stored program in response to polling and addressing messages from the computer. The operator is concerned only with entering data as required by the stored program and with replenishing forms, media, or cards.

USER REACTIONS

Burroughs TC users prove that networking is not a myth. TC terminals are most often employed in large networks, with the TC terminals used for collecting and storing data for transmission to a central site. Several users, however, make use of the TC 3000's peripheral capabilities by employing it as a data collection device for a network of TC terminals.

Insurance. An insurance company has placed TC 3600 terminals in each of its district agency offices across the country. The terminal systems collect and store insurance data during the day, and later transmit the day's transactions to a central computer site. The transaction data is used by the central computer for updating of master files, and the updated master file results are later transmitted back to the TC terminals for remote, unattended report writing. For this application, the TC 3600s are equipped with cassettes for data storage and autodial and auto answer/disconnect telecommunications options.

A large insurance broker has TC 3500s in 14 branch offices. The system is used for billing; invoices are prepared on the terminal at the branch offices and mailed locally. Simultaneously, all invoice information is captured on a cassette file for later transmission to the central office. Each TC unit has successfully replaced several Singer Flexowriters.

In addition to billing activities, each terminal handles several other transaction activities including file maintenance entry, nonbilled income, expiration data, and other specialized transactions. All these transactions are also captured on cassette, with printed audit trails. In the evening, all local stations are polled by a master TC terminal (equipped with magnetic tape) at the home office. The consolidated tape is then taken to a B 6700 mainframe for processing. This user is planning to go on-line with his system in order to make this centralized data base available to the local offices.

Wholesaler. A large wholesaler has TC terminals at each of his local offices that perform data collection during the day and batch transmission of transactions to a central site during the night. This user, however, makes use of a single TC 3600 at the central site as the hub of the telecommunications network. The master TC terminal is equipped with punch card equipment that is used as the collection medium for the day's transactions. When transaction transmission has been completed, the cards are then processed by a central computer to update files and create reports. By implementing the network in this manner, the user does not require data communications programs or hardware on his mainframe computer.

CONFIGURATION GUIDE

Each of the TC Series computing terminals comprises a programmable processing unit, a large keyboard for entering data, a console printer for output, and, on certain models, a standard media device — all housed in an integral unit. The TC 3000 Series looks like an accounting machine (the Burroughs L Series), and the newer TC 5000 Series is a compact, desktop unit.

TC 500, TC 700

Main memory for the TC 500 and 700 terminals is subdivided into control and user-programmable areas. The programmable area provides from 64 to 416 words of user program and data storage, depending on the model. The control area contains firmware.

A separate data communications memory includes a 256-character buffer for transmission and a 256-character buffer for message receipt. Messages received from remote computers are checked for accuracy and transferred to a receive record in user memory. Messages transmitted to the remote computer can be constructed in the transmit buffer or can be composed in user memory and then transmitted. The data communications processor functions independently of and concurrently with the main memory; firmware to implement data communications is stored in the memory area inaccessible to the programmer.

The accumulator, a fixed-storage 16-digit field within normal memory, serves as a working register for arithmetic, comparison, and shift operations.

The TC 500 and 700 have a 30-cps ball printer, and support the optional peripherals available for the TC 3000 line.

TC 3000

The TC 3000 Series is now in its second generation, and comprises six different models announced in 1974, 1975, and 1976. The models differ only in the speed and size of the printing unit. Table 2 summarizes the model distinctions within the TC 3000 Series.

All TC 3000 models make use of two independent processor units that use distinct memory areas. One processor is dedicated to data communications functions, and the other performs device control and executes user programs. The processors operate with a 3-microsecond machine cycle time; maximum main memory is 64K bytes, 51K of which is available to the user. As with the 5000 Series, ROM and a portion of semiconductor read/write

Table 2. TC 3000 Models: Distinguishing Features

Model	Printer Speed (cps)	Printer Width (in)
3631	30	15
3641	30	26
3831	60	15
3841	60	26
3931	90	15
3941	90	26

memory is reserved for the firmware. All models have the familiar Burroughs keyboard with typewriter and function keys, numeric pad, and indicator lights.

Six different printers are offered with the 3000 Series. TC 3000 models with "30" as their suffix use a 15-inch print carriage, and models with "40" as their suffix use a 26-inch carriage. The 3600 Series uses a 30-cps golfball type printer; the 3800 Series uses a 60-cps matrix printer; and the 3900 Series uses a faster 90-cps matrix printer. All printers are provided with a split platen forms handler and, optionally, dual- or single-pin feed and automatic paper-end detection.

See PERIPHERALS for a description of the optional devices available for the TC 3000 Series.

TC 5000

The TC 5000 Series is the newest member of the TC product line. Currently, there are two models in the line which differ only in the type and numbers of peripherals that can be attached to the processor. Table 3 summarizes TC 5000 model distinctions.

Table 3. TC 5000 Models: Distinguishing Features

Model	Storage Media	Self-Scan Display
5110	1 cassette, 2 opt	Opt
5113	2 cassettes	Std

All models of the TC 5000 Series make use of a Large-Scale Integrated (LSI) processor and MOS semiconductor memory with a 1-microsecond cycle time. This is the same processor that is being used in the Burroughs B 80 Series of small business computers, the S 1000 Document Processing System, and the AE 500 Series of audit entry systems. It makes use of a form of instruction lookahead to enhance operating speed. External events are all handled by means of a hardware interrupt system. Each I/O channel alerts the central processor when it is ready to process or transmit data, thus eliminating the need for the processor to scan channels continuously.

The TC 5000 models are equipped with 4K of ROM firmware and 16K of read/write memory. ROM and a portion of read/write memory are used by the microprocessing routines, with all remaining memory available for user programs and data buffers. Read/write memory may be increased to a total of 28K bytes. All models also include a 60-cps serial impact matrix printer (150-column line) with a pin-feed forms handler. The operator's console consists of a typewriter keyboard, a numeric pad, and 20 special function keys, 16 of which are user programmable. Thirty-four indicator lights, most of which are programmable, report machine status and provide prompting information to the operator.

The TC 5000 Series employs system confidence test routines that are exercised at machine start-up time and log results of the current machine state. The operator may also initiate operation of these routines, from any media storage device, as necessary.

All TC 5000 models can support a Self-Scan®* information display panel with a 256-character screen capacity. The display panel on the TC 5113 is standard.

TC 5000 models are distinguished by their storage media. The TC 5110 is equipped with a single cassette tape drive, and the TC 5113 is offered with two cassette tape drives. These cassette drives are similar to those used in earlier TC Series machines and are fully compatible with them.

PERIPHERALS

The following peripherals are available for use with the TC Series.

Cassettes

Cassette drives are standard on the TC 5110 and 5113 Series and are optional on the TC 500 and 3000 Series. Cassettes record at 800 bpi with variable-length records up to 256 bytes. Read/write speed is 10 ips and rewind speed is 60 ips. Forward and backward spacing to tape marks is supported at a speed of 30 ips.

Magnetic Tape

Computer-compatible (1/2-inch) magnetic tape drives may be attached to all TC models except the 5000 Series. A special feature is available that allows up to eight TC terminals to share a single tape drive. Recording is at 800 bpi.

Punched Card

All models except the TC 5000 Series may have punched card equipment attached. An 80-column or 96-column reader/punch is available that reads at 300 cpm and punches at 60 cpm.

Printers. High-speed chain printers may be attached to all TC models. Three models are available; all print 132 columns at speeds of 85, 160, or 250 lpm.

*Self-Scan is a registered trademark of the Burroughs Corp.

Other Devices. A Self-Scan® display may be attached to all 3000 and 5000 models; for the TC 5113 the display is standard. For all TCs, except the 5000 Series, a paper tape/edge punch card reader and perforator is available.

DATA COMMUNICATIONS

The entire TC line supports a variety of communications procedures. Burroughs has developed a number of its own protocols to meet different network requirements: standard poll/select; standard point-to-point (two-wire switched batch); standard remote job entry; CTCC (Central Terminal Computer Controller), which permits one terminal in a network to act as a central controller; and BLDC, Burroughs Data Link Control, which may be briefly described as the Burroughs version of IBM's new SDLC.

Burroughs has also recognized the *de facto* standards of IBM protocols, and supports several with the TC equipment: IBM 2260, 2740-II, and bi sync. A variety of transmission speeds are available — 75 to 9,600 baud asynchronous and 2,000 to 9,600 baud synchronous. Auto answer and auto call facilities are offered, as well as a full line of data sets (modems) to support TC configurations.

The TC 3000 Series and earlier units are equipped with an independent communications processor; the TC 5000 Series' central processor is fast enough to handle the communications workload and user programs. All terminals are capable of supporting two or more separate data communications procedures simultaneously. This feature is commonly put to use in TC network configurations where, for example, a TC terminal connected via leased lines to a distant host computer also controls a number of Burroughs TD display terminals.

Communications buffering varies from model to model. The TC 500 has fixed buffers of 256 characters for sending and receiving; in the 3000 Series, these buffers are programmable up to a maximum of 4,096 characters; and in the 5000 Series, they are programmable up to the limit of available memory.

TC terminals are capable of communicating with a large variety of devices:

- Other TC Series terminals.
- Burroughs TD Series input and display systems.
- Burroughs TT and TU Series teller terminals.
- Burroughs RT Series remote teller terminals.
- Burroughs TCS 1000 and B 770 communications processors.
- All Burroughs host mainframes and many non-Burroughs mainframes.

SOFTWARE

The original TC machines had fairly rigid firmware structures and buffering techniques, but these have been improved on newer models to allow loadable firmware and user programs, and more sophisticated data handling techniques. All these functions are transparent to the user; he is presented with a fairly simple environment in which he is able to create an application program.

Burroughs has recognized that much of the programming requirements within the TC terminals is basically small business data processing tasks. As a result, it developed a special version of COBOL, designed to run on its large mainframe computers, which would generate executable programs on TC terminals. Output of this COBOL cross-compiler would be supported by both local program loading facilities and by facilities for dynamic program loading down the telecommunications channel from the host computer. For those applications requiring more direct control of the machine, Burroughs also developed an Assembly language to generate interpretive TC user programs.

Also available for the TC Series is a full set of terminal utilities to aid in program debugging, remote compilation or assembly, and, recently, automatic self-confidence tests to perform user-initiated machine diagnostics.

MAINTENANCE

Burroughs maintains the TC Series terminals from its large network of over 300 branch offices throughout the U.S., as well as Europe. Maintenance is included in the rental terms for leased machines, and maintenance contracts are available for purchased equipment.

PRICE DATA

Model No.	Description	Purchase Price (Maint. not Incl) $	Mo. Rental (Maint. Incl) $	Mo. Maint. $
TC 500	4K user memory, dual pin feed carriage, 20 cps printer	8,790	268	47
TC 600	4K user memory, dual pin feed carriage, 20 cps printer (TC 600 offers faster throughput than TC 500)	8,890	282	55
TC 752	4K user memory, disc-based, 20 cps ball printer	10,500	303	59
TC 3631	4K user memory; dual pin feed carriage; 15" forms handling, 30 cps ball printer	16,000	500	85
TC 3641	4K user memory; dual pin feed carriage; 26" forms handling, 30 cps ball printer	16,500	520	83
TC 3831	4K user memory; dual pin feed carriage; 15" 60 cps matrix printer	18,000	570	104
TC 3841	4K user memory, dual pin feed carriage, 15" 60 cps printer	18,500	580	100
TC 3931	4K user memory, dual pin feed carriage, 15" 90 cps printer	19,000	600	108
TC 3941	4K user memory, dual pin feed carriage, 26" 90 cps printer	19,500	610	112

PRICE DATA (Contd.)

TC 5110	4K user memory, single cassette, single pin feed carriage, 15" 60 cps matrix printer	13,900	430	65
TC 5113	4K user memory, dual cassette, single pin feed carriage, 256 character Self-Scan®	16,900	525	85
	PERIPHERALS			
A 1495-1	Computer compatible magnetic tape unit	11,500	369	46
A 9490-25	Magnetic tape cassette subsystem	1,640	55	8
A 9222	Paper tape/edge punched card punch	1,990	54	60
A 9122-1	Paper tape/edge punched card reader	1,590	43	12
A 9114-1	80/96 column card readers	2,890	82	26
A 9419-2	80/96 column card reader/punches	10,410	274	92.93
A 9249-1	Line printer (85 lpm)	8,500	252	66.20
A 9355	256 character Self-Scan® panel display	1,990	55	10
A 4011	Memory (for each 2K)	625	19	2.18

COMPUTEK INC

Series 200 Programmable Data Terminals

OVERVIEW

The Computek Series 200 programmable data terminals are keyboard-oriented, intelligent CRT terminal display systems. The terminals are marketed by Computek as a multifunctional series.

The series includes stand-alone 200/10 models, dual-display 200/20 models, and quad-display 200/40 models. All can be equipped either with Computek's Microprogram Development System (MIDAS) or Computek's Floppy Disk Operating System (FDOS). All models can add additional Series 200 terminals through a daisy-chaining technique that will permit large communities of terminals to be connected inexpensively.

The standard display is a 2,000-character 12-inch screen, but 960- and 480-character screens are available on multiterminal models. Each display operates under the control of a separate display memory with 2K 10-bit words. All models can operate under the control of software stored in read/write memory, firmware stored in Read-Only Memory (ROM), or a combination of the two. The main system ROM and RAM memories can be mixed, up to a maximum of 64K bytes. Peripheral and auxiliary storage devices include single- and dual-drive cassette transports, dual-diskette drives, printers, and several communications interfaces. Communications rates can range up to 9,600 bps for synchronous or asynchronous transmissions. Computek also has several off-the-shelf interfaces (at a special factory quotation) for direct connection to a DEC PDP-11, Data General NOVA/SuperNOVA, or an IBM 360/370 system.

Systems software or firmware development can be accomplished by using a local terminal to develop programs in an on-line mode, communicating with an IBM System/360 or 370 using the MIDAS software package with cassettes, or using the FDOS package with floppy disks. Output can be a printed listing, a cassette, or a floppy disk that can be loaded into a terminal, or paper tape to be used in burning or masking ROMs. The MIDAS package includes a resident assembler, editor, debugger, tape utilities, and various other supporting software modules. The new Floppy Disk Operating System (FDOS) provides complete floppy-disk-based development facilities.

Two special applications-oriented versions of the 200 are available: the Computek Data Entry System (CDES) and a text processing system called ECONOTEXT. CDES is used for source data entry or key storage, while ECONOTEXT can be used by printers, newspapers, and publishers as an editorial subsystem. Both systems consist of CRT/keyboard workstations, diskettes, and data entry software.

System specifications for the Series 200 are presented in Table 1.

Computek has been marketing the Series 200 terminals since April 1972 and has over 3,500 installed. Customers are divided fairly evenly among OEM manufacturers, newspapers, and large end users such as the federal government. Primary uses for the terminals are for text editing, message processing, and data entry. Currently, emphasis is being placed on expanding the end-user customer base through the ECONOTEXT text processing system.

PERFORMANCE AND COMPETITIVE POSITION

Computek faces stiff competition at the low end of the intelligent terminal market from a number of manufacturers such as Datapoint, Raytheon, and Sycor. Many of these feature programmable terminals that can be expanded as the user's application grows, even to the level of a communicating small business system. While the standard Computek 200 terminal is a low-priced system and does have expansion capabilities and considerable flexibility in configuration, it is most competitive in the OEM market for large users with fairly fixed programs. This is because of its orientation toward easy development of firmware programs, including masked ROM and the conventional modular burned-in ROMs. The ECONOTEXT variant is

HEADQUARTERS

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Burlington MA 01803
(617) 272-8100

Table 1. Computek Series 200: Specifications

Processor	
Main Memory (bytes)	1K–64K
Word Length (bits)	16
Addressable Registers	5
Cycle Time (μsec)	0.65
Program Languages	Assembly
No. of I/O Chan	1 serial
Max. Devices/Chan	20
Auxiliary Storage	
Storage Medium	Cassettes/diskette
Capacity (bytes)	128K/242K
Transfer Rate (cps)	500/31.5K
Keyboard Entry	
Console Layout	Std typewriter; numeric pad; cursor, special functions
Code Generated	128
CRT Display	
Char Set	96 ASCII, 32 control
Max Char/Line	80 std, 40 opt
Max No. Lines	25 std, 12 opt
Page Printer	
Char Set	64
Max Char/Line	80
Rated Speed (cps)	100/30
Peripherals	
Card Reader	285 cpm
Card Punch	—
Paper Tape Reader	—
Paper Tape Punch	—
Line Printer	80 col, 250 lpm
Mag Tape Units	—
Others	MUX unlimited 200s
Line Transmission	
Line Facility	Switched/leased voice- or broadband
Transmission Code	ASCII, EBCDIC
Data Rate (bps)	110–9,600 bps
Synchronization	Sync or async
Interface	RS-232-C, MIL-188-C
Error Control	CRC
Compatibility	
Computer System	IBM S/360, 370; DEC: PDP-11; NOVA/SuperNOVA
Terminal Emulation	IBM 2780, 3275
Bell Data Set	103, 201A, 203

highly competitive for the shared-logic, medium-sized text processing user.

The ability to multiplex a series of 200 systems together under one controlling 200 system may also be of interest to users needing a large number of terminals. This concept differs from that behind other large terminal systems under a single controlling minicomputer, such as those made by Four Phase and others, in that processing logic is distributed and, as a result, the system has virtually unlimited growth capabilities. Multiplexors can be daisy-chained to one port to handle up to 32 Series 200s; these can each be quad models, so a display subsystem could conceivably have 128 displays.

The key factor in choosing systems of this type and size is probably the cost savings through the use of firmware/software combinations, to offset the cost of duplication which is inevitable in such a distributed system. While there are many users who would prefer the more standard arrangements of the clustered displays on a single large system, there are undoubtedly some users who would find Computek's type of system interconnection more useful because of the peculiarities of their applications.

CONFIGURATION GUIDE

The Series 200 consists of nine submodels, in addition to four ECONOTEXT models. Eight of these are stand-alone, dual-, or quad-terminal systems, and one is a special configuration for program development. They differ in the expandability of the system and in the number and type of terminals supported, as follows:

- Model 200/10A. Includes a 12-inch, 2,000-character CRT, removable keyboard, and basic processor. There are no provisions for expansion into a multiterminal system. The model can include memory up to 32K bytes.
- Model 200/10B. Like the 10A, except a serial asynchronous communications I/O interface and printer logic are standard features.
- Model 200/10C. Includes all 10B features, but has an EAU processor with a full hardware interrupt system and a 10-byte address recognition facility for communicating with peripherals. Up to 20 peripherals can be attached. The 10C can be expanded into a multiterminal model.
- Model 200/20-2000. A dual-terminal version of Model 200/10C; both terminals include 2,000-character CRT displays.
- Model 200/20-960. Like the 200/20-2000, except both displays have a 960-character capacity.
- Model 200/40-2000. A quad-terminal version of Model 200/10C; all terminals include 2,000-character CRT displays.
- Model 200/40-960. Like the 200/40-2000, but all terminal displays have a 960-character capacity.
- Model 200/40-480. Like the 200/40-2000, but all terminal displays have a 480-character capacity.
- Model M250 — MIDAS software development system. A 200/10 with 16K bytes of RAM, bootstrap ROM, an EAU processor, and an asynchronous interface. A dual cassette drive and printer are recommended.

Computek's ECONOTEXT text processing system combines the Series 200 intelligent terminals, storage and hard-copy peripherals, and comprehensive applications software in a total text-capture facility. ECONOTEXT is available in four models:

- Model E211 with a single workstation.
- Model E222 with two workstations.
- Model E233 with three workstations.
- Model E244 with four workstations.

Each model includes its own terminal processor with 32K bytes of internal memory and a text buffer, one or more CRT/keyboard workstations, up to six flexible disk drives, an optional printer, a communications interface, and complete terminal-resident text processing software. The ECONOTEXT VDT displays are available in a 2,000-

character format; 128 characters are displayed on a 14 x 20 dot matrix. VDTs may be located up to 1,000 feet from the master console.

All systems can include RAM, ROM, or a mixture of both types of memory. A system can currently address up to 65K bytes, but only 8K bytes can be ROM. In addition to the conventional 32-byte burned-in ROM chips offered in 1K and 2K modules, Computek offers masked ROM on an RPQ basis. Masked ROM has a high cost for the mask but a much lower cost per chip and is therefore cheaper for large users with fixed programs. It also requires less power, but cannot be changed on a per-chip basis like conventional ROM.

All systems from the 200/10C on up can address up to 20 peripheral controllers or interfaces, which can control single- or dual-cassette drives, communications lines, dual-diskette drives, printers, card readers, and various special attachments.

Multi-display terminal systems operate under control of a single display controller in a master unit. The M285 Communications Multiplexor, which attaches like an I/O device, can daisy-chain up to four Series 200 terminals to a single multidrop line (up to 16 CRT displays). Any or all of these can be quad-display terminals. The M285 can itself be daisy-chained into a subsystem of up to 32 terminals (again, these can be quad-display terminals) on a single I/O port. Since any of the I/O ports can support these subsystems, the terminal capacity of the system is considerably greater than that of the four displays that are directly controlled by the master station — in fact, it is virtually unlimited, since multiplexed systems can themselves attach a multiplexor.

There are three ways to develop Series 200 terminal application configurations. In the first, Computek assumes configuration responsibility and delivers fully operational terminals, using standard or special firmware in accordance with customer specifications. In the second, the customer develops application programming. Computek can then convert these debugged application programs into firmware, if desired. In both cases, the user can select what he requires from a library of editing functions; he specifies the communications interface, and he identifies peripheral devices and the manner in which they are to be used. The requisite number of program boards are produced and plugged into the terminal. The third way involves the ECONOTEXT and CDES systems, which are delivered with their own software which is ready to go for most text processing or data entry applications. With ECONOTEXT, the customer need only create his own text and story files, while with CDES he creates his own forms using the EASYFORM program.

Processor

Program instruction words are 16-bit parallel and are contained in read-only storage. Up to 32,768 16-bit words (64K bytes) can be stored in the processor, although, normally, fewer than 500 instructions are required for most applications. Programmable MOS circuits (PROMS) are used for program memory. The basic cycle of the processor is 650 nanoseconds. A normal data transfer takes place in two steps, or 1.3 microseconds. The processor contains five addressable registers, which are used to store the intermediate results of CPU computation.

The data format for bus transfer and display refresh is 10-bit parallel. The 2,048-word display buffer is random addressable and uses integrated MOS-circuit technology. The display processor functions separately from the system CPU. An optional cluster-selector module provides for the selection of one in two or one in four station terminals to be accessed by the master terminal's processor. The firmware program required to control the cluster selector and poll the station terminal keyboards ranges in length from 20 to 40 instructions. In cluster configurations, the size of any editing and/or peripheral device routines would be unaffected by the number of terminals in a cluster.

Display

The display is formed by a digitally controlled, 525-line, 12-inch CRT. Standard page format is 25 lines at 80 characters per line for a total of 2,000 character positions. The refresh rate of 60 frames per second assures flicker-free viewing. Characters are formed by a unique ROM character generator using a Computek-patented technique of digital interpolation that yields very clear, precise characters formed on a 14 x 20 dot matrix. For lowercase characters, additional vertical spaces are available in the matrix. See Table 2 for alternate display sizes in dual- and quad-display terminals.

The 10-bit display-character field specific to the Series 200 terminal employs seven bits to contain the ASCII codes; the remaining three bits are used to provide such features as blinking data, underlining, protected data, tab stops, and intensified data displays. Using the three available bits, any three of these features are possible. If the alphabetic character set is held to uppercase letters, four bits then become available with each character to handle the display attributes features.

Table 2. Computek Series 200: Screen Capacities

No. of Displays/ Subsystem	Lines/Display	Char/Line	Char/Display
1–4	25	80	2,000
2–4	12	80	960
4	12	40	480

Keyboard

The keyboard is separately mounted. It contains the standard ASCII alphanumeric character set, a cursor control group, a function key group, and an accounting-oriented 12-key numeric group.

Peripherals

FL-1 Floppy Disk: 242,944-byte capacity; dual drive with 31.3K-byte transfer rate; IBM 3740-compatible.

PTR-306 Printer: 100-cps dot matrix printer; 5 x 7 or 7 x 9 matrice; 64- to 128-char set; 80 col.

PTR-210 Printer: 210-lpm impact printer; 132 col; 64-char set.

PTR-101AL Printer: 165-cps dot matrix printer; 64- to 128-char set; 132 col.

CR 285 Card Reader: 285 cpm; 500-card hopper.

TC1 and TC2 Cassette Drives: single and dual drives, respectively; 128K-byte capacity; 500-cps transfer rate.

COMMUNICATIONS

The serial I/O port is an integral part of the Series 200 standard terminals and functions as a general-purpose interface between the terminal and the central computer. The interface employs a 10-bit asynchronous format from 110 to 1,200 bps using selected internal clocks; it can also operate synchronously up to 9,600 bps using an external clock (commonly derived from a modem or data set). Rates higher than 9,600 bps can also be accommodated for very low additional charges.

In the data communications environment, serial interfaces permit incremental data transmission speeds between 110 and 9,600 bps. Series 200 terminals operate either synchronously or asynchronously in half- or full-duplex mode. In addition to standard asynchronous, synchronous, and EIA RS-232-C interfaces, Computek has a standard current loop (Teletype) interface.

Special parallel interfaces are also available for direct interface with the DEC PDP-11, Data General NOVA/SuperNOVA, and IBM 360/370 computers. The maximum parallel-output data transfer rate can be as high as 200,000 10-bit bytes per second. These are all obtained on an RPQ basis.

SOFTWARE/FIRMWARE

The Microprogram Development System (MIDAS) serves to generate both software and firmware for any Series 200 system. MIDAS consists of an assembler, an editor, a debugger, a cassette utility, a binary interchange program for making ROM manufacturing paper tapes, a cross-reference utility, and a MIDAS ROM. Model 250 systems, designed to support MIDAS, usually include 8K bytes or 16K bytes of random access memory, a 512-word bootstrap ROM, a 200/10C-type EAU processor, dual cassette units, and a printer. MIDAS outputs a printed listing, programs on cassette capable of being loaded and run on another 200 system (software), or paper tape for running a ROM burner. The user can use his own Teletype interfaced to a current loop interface for generating paper tape, or can send his debugged program to Computek for punching and burning of ROMs.

The Series 200 Floppy Disk Operating System (FDOS) includes a diskette macro assembler, source text editor, linker loader, two screen-oriented debuggers, and a library of utility programs. The heart of the system is the FDOS Kernal Program, which provides a link between all systems programs and the FDOS so users do not have to reprogram the terminal system as long as power is available.

Two levels of diskette drivers are provided with FDOS. The basic level of physical drivers will read, write, and pack and unpack records from the disk addressed by drive, track, and sector number. Logical drivers provide automatic updating of the file directory as well as OPEN, CLOSE, and CREATE commands. FDOS runs on either a stand-alone or clustered Series 200 configuration and requires 16K bytes of memory.

Numerous editing functions are possible with the terminal's microprogrammed processor. These include the range of conventional editing techniques that can be performed on many different types of CRT intelligent terminals, and further include such complex editing operations as character and word transposition and right/left margin justification. Editing functions can be initiated at the terminal keyboard or by a host computer. Typical editing functions include:

- Display cursor (up, down, right, and home, with or without wraparound).
- Position cursor by row and column coordinates. This function permits control of cursor movement by the central computer.
- Write one character and move cursor to next character.
- Begin and end blink, intensify, underline, and protect data.
- Line control and carriage return.
- Move cursor to tab stop.
- Set and clear tabs.
- Read cursor.

More complex editing functions permit erasure of an entire line or erasure from the cursor to the end of the line, and the insertion (or deletion) of a character in a given row, from the cursor to the end of the line. The most complex editing instructions include:

- Character insert (delete) from the cursor or from the home position to the end of the page.
- Line insert (delete).
- Scroll mode.
- Page erase.
- Erase from cursor to end of page.

The ECONOTEXT applications software contains three operating modules: Editing, File Management, and Communications. The Editing module allows full editing and movement of text on the VDT screen(s). The File Management module permits the operator to store, retrieve, and manipulate text on the diskettes as well as create text directories, define programmable function keys, and access print routines. A unique Command Mode facilitates screen and file manipulation functions. The Communications module allows ECONOTEXT to transmit text one-way to the host over wire service lines, or by special option to communicate two-way with a remote central newsroom facility.

ECONOTEXT's complete text editing facilities provide the ability to move the cursor on word, sentence, and paragraph boundaries as well as text scrolling up and down through the text buffer. ECONOTEXT provides a complete set of display attributes to aid in editing. ECONOTEXT also includes a complete set of file commands to facilitate the movement of text to and from the floppy disks. Special commands allow the user to compact disk text to free mass storage, to reformat disks, to rename stories, and to access disk queues and directories.

The CDES applications software is also divided into three parts, each of which is executed at the terminal without host processor intervention:

- The CDES form creation program (EASYFORM) allows the user to create forms on the terminal's master console and store them locally on the terminal's diskettes.
- The CDES Supervisor Program shows system status information to user personnel, opens terminals for operator use, and provides initialization procedures.
- One or more Data Entry Programs are used in a data entry production mode to call up forms; to enter, edit, verify, update, and locally store data; and to handle communications to the host, allocate system resources to user tasks, and schedule processor and peripheral functions. The Data Entry Programs run under a real-time operating system.

The form creation program (EASYFORM) is used to create forms, tables, maps, and data entry procedures. Through a command mode, EASYFORM provides operator prompting. Complete register, table checking, and duplication operations on each field of the form are possible.

The CDES Supervisor Program is used on the system's master console to control and monitor system use. Through the Supervisor Program, one or more terminals can be "opened" for operation, Data Entry Programs can be loaded, and initialization procedures such as setting time and date can be implemented. Terminal status is available on request through the Supervisor Program.

The CDES Data Entry Programs, in conjunction with the real-time operating system, initiate and schedule all terminal activities, handle operator identification and passwords, provide file management functions, and execute communications to and from the host. Communications can be initiated while data collection activities are occurring at the workstations. Data Entry Programs also handle the transfer of data to and from the local CDES diskettes. Disk utilities are provided for file initialization and maintenance. A feature of CDES is that all file formatting is done "on the fly" as data is actually being stored, eliminating the need for reformatting jobs.

MAINTENANCE

On-site maintenance is either provided by Computek or by a number of subcontractors who feature a wide variety of preventative and diagnostic maintenance contract plans. Factory-level systems engineering support is available from four regional centers located at Thousand Oaks CA, Burlington MA, New York City, and Bethesda MD. Maintenance in areas other than these is provided either by General Automation or a third party.

PRICE DATA

Prices supplied by Computek are purchase only. All leasing arrangements are handled through a third party. Maintenance prices are on a negotiable basis with Computek.

PRICE DATA (CONTD.)

Model Number	Description	Purchase Price (Maint. not Incl) $
200/10A	Terminal, CPU (no memory)	4,835
200/10B	Terminal, CPU with printer logic and async comm interface	4,921
200/10C	Terminal, CPU with extended arithmetic, printer logic & async comm, upgradable to 200/20	5,705
200/20-2000	2-Terminal System like 200/10C but with 10-byte address field; both CRTs have 2,000 char	7,818
200/20-960	2-Terminal System like 200/20-2000 but both CRTs have 960 char	6,698
200/40-2000	4-Terminal System like 200/20-2000	12,695
200/40-960	4-Terminal System like 200/20-960	10,050
200/40-480	4-Terminal System like 200/40-960 but each terminal has 480 char	8,950
E211-2000	Stand-alone Unit: includes 1 table-top text processing station & controller in plastic cabinet with dual floppy diskette unit in separate table-top enclosure; station must be within 10 ft of diskette units; workstation has usable text-buffer length of 7,600 char*	11,250
E222-2000	Dual System: includes 2 metal-cabinet table-top text processing stations & separately packaged color-coordinated racked controller with dual floppy diskettes; stations delivered with 50 ft of cable to connect to controller; each work station has usable text buffer of 5,600 char*	15,000
E233-2000	Trio System: includes 3 metal-cabinet table-top text processing stations & separately packaged color-coordinated racked controller; each workstation has usable text buffer of 3,600 char*	18,750
E244-2000	Quad System: includes 4 metal-cabinet table-top text processing stations & separately packaged color-coordinated racked controller with dual floppy diskettes; stations delivered with 50 ft of cable to connect to controller; each workstation has usable text buffer of 3,600 char*	22,500
	Memory	
RAM 2	2,048-wd MOS memory	1,700
RAM 4	4,096-wd MOS memory	1,900
RAM 6	6,144-wd MOS memory	2,100
RAM 8	8,192-wd MOS memory	2,300
RAM 10	10,240-wd MOS memory	3,230
RAM 12	12,288-wd MOS memory	3,430
RAM 14	14,336-wd MOS memory	3,630
RAM 16	16,384-wd MOS memory	3,830
ROM 5	Bootstrap, 512 bytes	225
ROM 1	1,024-byte ROM	540
ROM 2	2,048-byte ROM	920
	Options	
FY1	Async Interface	375
FY2	Sync Interface	600
FY4	Current-Loop Interface	375
FY5A	EIA RS-232-C Interface	230
EAU1	Extended Arithmetic Unit	175
FL1	Dual Floppy Disk with Controller	4,725
CR285	Card Reader with Interface	3,375
TC1	Single-Drive Tape Cassette with Interface	1,975
TC2	Single-Drive Dual Cassette with Interface	2,950
PTR-306	Printer, 100 cps	2,300
PTR-210	Printer, 210 lpm	7,875
PTR-101AL	Printer, 165 cps	4,935
PTR-30	Printer, 33 char/sec	1,825
	Printer Interface	250
M285	Multidrop Multiplexor Adapter	950
M290	Diagnostic Test Console	1,995

*Additional text buffer area, floppy disk drives, & character printer available as extra-cost items.

COMPUTEK INC

Series 216 Intelligent Terminal System

OVERVIEW

The Computek 216 is the initial member of Computek's new DISPLAY 16 family of terminals, which will develop into a complete range of terminal products. The system is offered in stand-alone as well as clustered versions, with as many as four alphanumeric display stations for distributed processing applications, including text editing, data entry, and message processing.

The 216 offers users a 16-bit LSI microcomputer terminal processor with up to 128K bytes of user memory. Communications interfaces include asynchronous, synchronous/BSC, and SDLC protocols. Peripheral and auxiliary storage devices include single and dual mini diskette drives, cartridge disks, line and serial printers, magnetic tape drives, and punched paper tape I/O. System specifications for the Computek 216 are presented in Table 1.

Computek supports user-programmability via a disk-based program development system which provides the user with an assembler, editor, screen-oriented debugger, relocatable loader, and screen-oriented utilities. System subroutines including an Input/Output Control System (IOCS), and real-time subroutines are available. An interrupt-responsive, multi-tasking operating system controls terminal operation. The Computek Data Entry System (CDES II) is available to the user for their data entry and on- or off-line text editing applications.

The Computek 216 is a high performance complement to the Computek Series 200 terminals. Primary uses for the terminals are for distributed processing applications involving data entry, message processing, and stand-alone processing. Currently, emphasis is being placed on expanding the end user customer base through the data entry system (CDES II).

PERFORMANCE AND COMPETITIVE POSITION

Computek faces stiff competition in the stand-alone and clustered intelligent terminal market from a number of manufacturers, such as Datapoint, Four Phase, Harris, Raytheon, and Sycor. Many of these feature programmable terminals that can be expanded as the user's application grows, even to the level of a communicating small business system. The Computek 216 is a low priced system with considerable flexibility in configuration, but limited expansion capabilities. The use of the General Automation Control III operating system, FMS-16 File Management System and FORTRAN gives the 216 good standalone capabilities against minicomputer competition. The addition of the CDES II software places the 216 in a highly competitive position for the medium size data entry user.

Computek offers a comprehensive line of software which allows users to take full advantage of the terminal's processing power. Support for remote batch 2780 is provided. Extensive application packages are available for data entry applications.

Data communications support for the Computek 216 is quite flexible, thereby adaptable to a wide variety of communications environments. The hardware interfaces plus the programmability of the 216 allows communication with any host processor.

CONFIGURATION GUIDE

The Computek 216 is available in three models. They consist of both stand-alone and clustered configurations. They differ in the expandability of the system, and in the number and type of terminals supported, as follows:

- Model 216/10. A stand-alone alphanumeric display terminal with up to 80K bytes of memory, 1,920 character display, and removable keyboard.
- Model 216/20. A clustered alphanumeric display terminal with up to 128K bytes of memory, up to four local 1,920 character display stations located up to 50 feet from the processor, and removable keyboard(s).
- Model 216/30. A clustered alphanumeric display terminal with up to 128K bytes of memory, up to four remote 1,920 character display stations located up to 2,000 feet from the processor, and detachable keyboard(s).

Each model includes its own 16-bit General Automation GA16/110 microcomputer, which features bus-oriented architecture, and 16 general purpose registers.

The Computek 216 is a modularly designed intelligent terminal system that can be configured according to user requirements. The terminal system may include

HEADQUARTERS

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Table 1. Computek 216: Specifications

Processor	
Main Memory (bytes)	Up to 128K
Word Length (bits)	16
Addressable Registers	16
Cycle Time (μsec)	3.5
Software	Assembler, Editor, Screen-oriented debugger, Utilities, IOCS, Real-Time subroutines, CDES II, Text Editing
Auxiliary Storage	
Storage Medium	Single or Dual Mini Diskette/ Cartridge Disk
Capacity (bytes)	80K per drive/5M–10M
Keyboard Entry	
Console Layout	63-key typewriter style, 10-key numeric pad, 42 function keys
Code Generated	ASCII
Detachable Keyboard	Yes
CRT Display	
Screen Size (char)	1,920
Characters/Line	80
Lines/Display	24
Character Set	128; 256 opt
Character Generation	7 x 9 dot matrix
Peripherals	
Line Printers	200 lpm; 600 lpm; 132 column
Serial Printers	60 cps; 165 cps, 132 column
Magnetic Tape	9-track, 800 bpi NRZI
Paper Tape	Reader: 500 cps; Punch: 75 cps
Data Transmission	
Line Facility	Voicegrade
Transmission Mode	HDX/FDX
Transmission Code	ASCII; EBCDIC
Line Speed (bps)	110–19,200 async; 1,200–9,600 sync/BSC; 110–9,600 SDLC
Synchronization	Async; sync/BSC; SDLC
Interface	RS-232C
Error Control	CRC opt
Compatibility	
Computer System	Any
Terminal Emulation	
Bell System Data Set	
First Delivery	August 1977

one or two mini diskette drives for low volume applications, whereas large volume applications may be configured with up to four 10 million byte cartridge disk drives. As many as four industry compatible 9-track tape drives can be accommodated. The system may contain either serial or line printers rated at 60 or 165 cps, or 200 or 600 lpm respectively. As many as eight high speed peripheral devices can be accommodated via the optional Multiple High-Speed Data Channel (MHSDC). An optional GA16/220 processor adds a memory port, an integral Teletype controller, and additional peripheral controls to the standard GA16/110.

Memory on the 216 can be added in increments of 8K, 16K, or 32K bytes. The maximum memory configuration is 128K bytes of MOS semiconductor RAM with an access time of 400 nanoseconds. Processor efficiency is improved through interleaved DMA operation. Memory organization features a linked-list structure for display refresh. Each list, containing up to 1,920 characters of screen data, can reside anywhere in memory, and is linked (or chained) to the next list by a special "link" word which precedes the list. This technique allows optimum memory packing and eliminates data movement required with an individual display buffer concept, thereby increasing throughput. In addition to the 216's RAM modules, a special memory package consisting of 4K bytes of programmed ROM is available for smaller 216 configurations.

PROCESSOR

The Computek 216 contains a General Automation 16-bit GA16/110 microcomputer which features bus oriented architecture, 16 general purpose registers in dual 8 register banks, vectored priority interrupts, interleaved DMA, and hardware multiply/divide. Access is provided to programmed I/O devices, keyboards, and the communications interface by an I/O bus. An optional Multiple High-Speed Data Channel (MHSDC) I/O expander provides access to high-speed peripherals including disk, tape, and line printers. Display screens access data directly from main memory via the DMA bus, allowing standard memory reference instructions to manipulate screen data. The processor also features a 500 nanosecond microcycle, a 3.5 microsecond average instruction cycle, 128K bytes direct addressability, and eleven addressing modes. An optional GA16/220 processor adds a memory port, integral Teletype controller, and additional peripheral controls.

Display

The display unit consists of a standard 12-inch (diagonal) CRT; the display arrangement consists of 24 lines of 80 characters each, totaling 1,920 characters. The display is refreshed on a DMA basis from main memory at a rate of 60 Hz; a 50 Hz refresh rate is optional. The full 128 character ASCII character set is displayable, including upper and lower case alphabetics, numerics, specials, and control symbols. The standard character set is optionally expandable to 256 characters. Each character is displayed on a 7 x 9 dot matrix in white or green (optional). Character highlighting includes full or half intensity, blanking (or horizontal slash), blinking, underscore, and reverse video. The cursor may be displayed in reverse video or as a blinking or non-blinking underscore.

Keyboard

The 216 contains a 93-key, typewriter-style detachable keyboard. Thirty-two function keys which may include a 10-key numeric pad can be programmed by the user. The keyboard also features six programmable lamp indicators, expandable to twelve. Special keyboards for text editing and data entry are available.

Peripherals

- Minidiskette: Single or dual drive unit, 80K byte capacity.

- Cartridge Disk: One fixed disk and one removable disk cartridge; 10 million byte capacity; 200,000 bytes-per-second transfer rate.
- Magnetic Tape: Industry compatible 9-track, 800 bpi NRZI; 20,000 bytes-per-second transfer rate.
- Serial Printers: Centronics 700 60 cps, 132 column bi-directional matrix printer.
- Line Printers: Data Printer V-132-C 600 lpm, 132 column drum printer; Tally 2200 200 lpm, 132 column matrix printer.
- Paper Tape: Available as a combined reader/punch or as separate reader and punch units; 500 cps read, 75 cps punch.

DATA COMMUNICATIONS

The Computek 216 offers any one of three communications interfaces: asynchronous, synchronous/BSC, and SDLC protocols. The asynchronous serial interface will operate in either full- or half-duplex mode, with switchable data rates of 110, 300, 1200, 2400, 4800, 9600, and 19,200 bits per second. The transmission code is 8-level, 10- or 11-unit ASCII code.

The synchronous interface handles Binary Synchronous Communications protocol, and features CRC checking and switchable data rates from 1200 to 9600 bits per second; internal or external timing may be used. Either 8-level ASCII or EBCDIC can be used as the transmission code.

The SDLC interface handles double buffered full- or half-duplex operation with automatic framing, zero insertion/deletion, and data selection at rates up to 9600 bits per second. The interface provides protocol compatibility with the IBM SDLC communications protocol.

All interfaces are RS-232C compatible. The hardware interfaces plus the programmability of the 216 allows communication with any host processor.

SOFTWARE

The real-time Terminal Operating System (TOS) supports a multi-tasking environment and mini floppy diskette. Program scheduling can be controlled through external interrupts or upon user demand. All system resources are dynamically allocated by the software. The Input/Output Control System (IOCS) provides a central facility for performing operations on peripheral devices. Real-time subroutines are provided for dynamic schedule modification and other real-time services. Program development is supported by an assembler, an editor, a screen-oriented debugger, a relocating loader, and screen-oriented utilities.

Control III is a multitasking real-time operating system which supports assembler and FORTRAN. A File Management System (FMS-16) is also available with Control III. Two operating systems are available with the 216: TOS and GA's Control III.

The Computek Data Entry System (CDES II), operating software, is a source data collection system consisting of three modules:

- The CDES II field-oriented two pass forms creation program (EASYFORM) features unique operator screen prompting and allows complete edit constraints.
- The CDES II Supervisor Program initializes the system, maintains system security, and configures the terminals for operation.
- The CDES II Data Entry Programs consist of automated data entry procedures, complete arithmetic functions, operation in Enter and Update modes, and concurrent I/O processing.

MAINTENANCE

Maintenance and service are provided by over 85 Computek/General Automation offices located throughout the United States. Internationally, all services are available through offices of General Automation.

PRICE DATA

Prices supplied for the Computek 216 are purchase prices only. Lease plans for periods of 3, 4, and 5 years are available. Maintenance prices are on a negotiable basis with Computek.

PRICE DATA (Cont.)

Model Number	Description	Purchase Price $
216-10	Stand-alone single station terminal (includes GA16/110 processor, display monitor, and detachable keyboard)	4,400
216-20	Clustered local station terminal; single display station (includes GA16/110 processor, display monitor, and detachable keyboard)	5,290
	Clustered local station terminal; dual display stations (includes GA16/110 processor and 2 local station display monitors with detachable keyboards)	7,650
	Clustered local station terminal; three display stations (includes GA16/110 processor and 3 local station display monitors with detachable keyboards)	10,110
	Clustered local station terminal; four display stations (includes GA16/110 processor and 4 local station display monitors with detachable keyboards)	12,475
216-30	Remote cluster; single display station (includes GA16/110 processor and a remote display station with detachable keyboard)	6,130
	Remote cluster; dual display stations (includes GA16/110 processor and two remote display stations with detachable keyboards)	8,610
	Remote cluster; three display stations (includes GA16/110 processor and three remote display stations with detachable keyboards)	11,085
	Remote cluster; four display stations (includes GA16/110 processor and four remote display stations with detachable keyboards)	13,560
2160-3000	Local display expansion; two stations to three stations (includes controllers and local display station with detachable keyboard)	2,460
2160-3010	Local display expansion; one or three stations to two or four stations (includes controllers and a local display station with detachable keyboard)	2,360
2160-3020	Remote display expansion; adds one remote display station to any Model 216-30 configuration (includes a controller and remote display station with detachable keyboard)	2,480
1622-0001	GA16/220 Expansion module (adds DMA feature, TTY controller, and additional controls to the standard GA16/110 processor)	460
1622-0012	System console interface option (implements processor control from a Teletype console or remote master computer; includes a 256 word RAM with accommodation for a 256 word ROM; does not include an IPL Bootstrap ROM; requires feature 1622-0001 and an external Teletype console via the GA16/220 serial I/O port)	280
1622-0013	System console interface option with IPL (same as 1622-0012 above but includes a multi-device IPL Bootstrap ROM to autoload from the 3321 or 3323 Paper Tape unit or 3346 Disk unit; requires feature 1622-0001)	380
1611-0102	4K Byte piggyback RAM (includes 4K bytes of RAM memory and accommodates 128 bytes of PROM for IPL; plugs into GA16/110 processor)	485
1611-1030	4K Bytes PROM/4K byte RAM (plugs into GA16/110 processor)	975
1622-0203	8K Bytes RAM (requires one memory slot on a Model 216-10, 216-20 or 216-30)	650
1622-0204	16K Byte RAM (requires one memory slot on Model 216-10, 216-20 or 216-30)	1,040
1615-0208	Multiple High-Speed Data Channel – MHSDC (provides 8 DMA high-speed data channels for attaching peripheral controllers; requires one I/O slot on Model 216-10, 216-20 or 216-30)	600
2160-1012	Parallel Printer/Asynchronous Communications Interface (includes a parallel printer and an RS-232C communications interface; requires one slot on Model 216-10 or 216-20 or 216-30 equipped with a 2160-1010 keyboard controller)	300
1571-0011	Synchronous/BSC Communications Controller (provides twin buffers for a full-duplex line, RS-232C connector and switches to select internal or external clocking and test loopback; requires one slot on any model)	700
1572-0001	Cyclic Redundancy Generator/Checker (provides CRC-16 cyclic redundancy checking for BSC protocol or CCITT-16 cyclic redundancy checking for SDLC protocol; requires feature 1571-0011 and one slot on any model)	400
1578-0011	Synchronous Data Link Controller (provides twin buffers for a full-duplex line and RS-232C connector; requires one slot on any model)	750
3346-1500	Disk Storage Drive and Controller; 10 million bytes; controller accommodates four 10 million byte drives	12,000
3346-1510	Disk Drive; 10 million bytes; requires 3346-1500	8,000
3331-1011	Magnetic Tape Drive and Controller; 9-track 800 bpi; controller accommodates four 9-track, 800 bpi drives; requires GA16/220 Expansion Module (1622-0001) and I/O Expander (1615-0208)	10,000
3331-1120	Magnetic Tape Drive; 9-track 800 bpi; requires 3331-1011	4,000
3321-1200	Paper Tape Reader and Controller	2,500
3322-1000	Paper Tape Punch and Controller	3,000
3323-1200	Paper Tape Reader and Punch with Controller (combines 3321-1200 and 3322-1000)	5,000
3353-1001	Line Printer and Controller; 600 lpm, 132 columns; requires GA16/220 Expansion Module (1622-0001) and I/O Expander (1615-0208)	14,500
3354-1200	Low-Speed Line Printer and Controller; 200 lpm, 132 columns; requires GA16/220 Expansion Module (1622-0001) and I/O Expander (1615-0208)	7,000
2160-4000	Low-Speed Serial Printer and Controller; 165 cps, 132 columns; requires Printer and Asynchronous Serial I/O Interface (460-1012)	4,935
1615-0208	Multiple High Speed Data Channel (MHSDC - provides 8 DMA high-speed data channels for appropriate peripheral controllers)	600

DATA TERMINALS AND COMMUNICATIONS (DTC)

Microfile Computer System

OVERVIEW

The DTC Microfile intelligent terminal system is designed to provide computer capability without computer complexity. The two available models of the Microfile combine a micro-computer, two or four flexible disks, and up to 56K bytes of memory into a simple-to-operate computing system. Applications for the Microfile range from general computing to word processing.

Linking a Microfile computer system to a high-quality printing device (such as a DTC terminal) provides a word processing system with automatic letter writing, text editing, and document processing capabilities. The addition of the unique DTC electronic mail feature provides unattended message forwarding worldwide via TWX, Telex, or direct distance dialing.

A Microfile computer system interacts through a standard EIA interface either with a host time sharing system or with a second data terminal at speeds from 110 to 9,600 bps. An internal file management system controls data file allocations, cataloging and access. The system has built-in diagnostics and error checking systems.

Standard software includes a disk operating system, a powerful text editor, mailing list maintenance, and an automatic letter writer. Optional software includes an assembler, an extended BASIC interpreter with full sequential and random access file features, an ASCII-compatible FORTRAN compiler, and a document processor.

PERFORMANCE AND COMPETITIVE POSITION

The compact DTC Microfile computer system incorporates high-volume data storage in both models offered by DTC — the MK IIA and the MK IV. The MK IIA and the MK IV are based on the Intel 8080A microprocessor. The MK IIA combines the 8080A microprocessor with a dual floppy disk storage unit, providing 600,000 bytes of storage. The MK IV is equipped with twice the disk storage capacity of the MK II, or 1.2 million bytes. Both Microfile units include 8K bytes of random access memory as standard equipment and offer optional memory to a maximum of 56K bytes.

While the Microfile is a general-purpose computer with disk storage, the software offered by DTC supports Microfile use as a word processing system. The high quality of the DTC typewriter terminal also favors the work processing application.

The availability of extended BASIC and FORTRAN for the Microfile enables users to develop special-purpose applications for the Microfile.

DTC's competition in microprocessor-based computer systems includes Altair, Imsai, and Cromemco. DTC, however, has a marketing edge in the word processing market. On the other hand, Altair and the other microcomputer manufacturers have the advantage of experience with microcomputer systems. The Microfile system is in the high end of the price range, probably because of the software provided.

SYSTEM DESIGN

The DTC Microfile microcomputer system is a modular combination of microprocessor, memory, and floppy disk drive. The two models offered differ only in disk storage capacity. The Microfile MK IIA supports 600,000 bytes of disk storage and the Microfile MK IV provides 1.2 million bytes of disk storage. The DTC Microfile specifications are presented in Table 1.

The Intel 8080A is the microprocessor around which the Microfile is constructed. The 8080 microprocessor is used extensively in the computer terminal industry and is currently the standard by which all microprocessors are measured. The Intel 8080 is an eight-bit word machine. DTC has equipped the standard Microfile with 8K bytes of RAM and 7K bytes of ROM. The main memory may be expanded from the basic 8K to a maximum of 56K in 16K increments. The ROM is used to store the nucleus of the DTC control program that is used to operate the Microfile.

Removable flexible disks are used to provide a mass storage capability for the DTC Microfile. Each flexible disk can store 300,000 characters. The data stored on the floppy disk drives can be accessed in an average of 200 milliseconds. The MK IIA is equipped with a

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Table 1. DTC Microfile Computer System: Specifications

Processor	
Type	8080A microprocessor based
Memory-RAM	
Minimum	8K bytes
Maximum	56K bytes
Increment	16K bytes
Memory-ROM	7K bytes
Flexible Disk Storage	
Configuration	Dual-disk single-drive (MK IIA) Quad-disk dual-drive (MK IV)
Storage Capacity	300K + character per disk
Access Time	200 msec average, 260 msec maximum
Storage Format	
Tracks/disk	77
Sectors/track	32
Characters/sector	128
Data Communications	
Communications Code	ASCII
Communications Mode	Asynchronous
Speed	110, 300, 1,200, 2,400, 4,800, 9,600 bps switch- or software-selectable
Duplex	Full- or half-duplex
Peripheral Interface	
Interface Type	RS-232C
Number of Peripherals	Two maximum (including data communications)
Compatibility	
Bell Data Sets	103/113 and 212
Software	
	Text Editor Letter Writer Document Processor BASIC 8080 Assembler FORTRAN

dual-disk single-drive unit; while the quad-disk dual-drive unit is standard on the MK IV.

Two RS-232C devices can be interfaced simultaneously with any Microfile unit. Any user-selected RS-232C devices can be attached to the Microfile. A popular configuration combines the Microfile with a "dumb" terminal of some sort and a data communications line to produce an inexpensive "intelligent" terminal with significant disk storage.

SOFTWARE

A full complement of software is provided to transform the DTC Microfile into either a complete word processing system or a general-purpose computer system. An internal file management system controls data file allocations, cataloging, and access. The system has built-in diagnostics and error checking systems.

Standard software includes a powerful text editor, mailing list maintenance, and an automatic letter writer which merges names and addresses into a letter to produce a personalized document. An optional document processing software system permits the Microfile to perform a complete array of word processing functions.

An additional collection of optional software permits the Microfile to be programmed and used as a general-purpose computer system. Included in the general-purpose software collection are an 8080 Assembler, an Extended BASIC interpreter, and a FORTRAN compiler. The BASIC interpreter is equipped with full sequential and random access file features, and the FORTRAN compiler is compatible with ANSI.

DATA COMMUNICATIONS

The Microfile may be interfaced with a wide variety of data communications networks. The asynchronous ASCII communications link is standard, but DTC will provide other communications protocols on request.

Any RS-232C-compatible data set can be used to interface the Microfile with the common carriers. Three character parity options — even, odd, or none — are available with the Microfile.

MAINTENANCE

The DTC Microfile is supported by Data Terminals and Communications' factory field offices and through third-party maintenance arrangements with the Dow Jones Service. When the Microfile is leased, maintenance is usually included in the lease price and is provided by DTC. Maintenance contracts are available for purchased units as well as for leased units.

Malfunctioning modules can be repaired at the factory on a time-and-materials basis with a turnaround of eight working hours or less. DTC provides a 90-day factory warranty on all parts and labor.

PRICE DATA

Description	Purchase Price	Lease (Incl Maint) 1-Yr	2-Yr	3-Yr	Maint
	$	$	$	$	$
MK IIA Dual-Disk System	4895	193	184	171	40
MK IV Quad-Disk System	7230	270	256	238	45
Optional Items					
16K Memory Addition	1000	37	35	33	4
Programming Aid (Debug Console)	500	NA	NA	NA	NA
Pedestal Enclosure	250	8	8	7	NA
Workstation Enclosure	395	13	12	11	NA
BASIC (software)	500	One-Time Rental Fee			
Document Processor (software)	500	One-Time Rental Fee			
8080 Assembler (software)	350	One-Time Rental Fee			
FORTRAN	500	One-Time Rental Fee			

Notes:
NA — Not applicable

DATAPOINT CORP

1100 and 1500 Series Intelligent Terminals

The Datapoint 1500 Dispersed Processor provides its user with intelligent data entry and local data processing, as well as concurrent communications with remote locations.

OVERVIEW

The Datapoint intelligent terminals are designed to support both local and remote batch and real-time processing. A variety of complementary software and hardware is available, depending on the model. The software includes a disk operating system with utilities, several standard and proprietary procedural languages, several batch terminal emulators of major mainframe computers, and turnkey systems.

Four diskette-based models are offered in the Datapoint 1100 and 1500 Series: the 1130, 1150, 1170, and 1500. Each model provides two types of memory access: program code is stored in random access memory (RAM), while the operating system is contained in read-only memory (ROM). Differences between the models consist of different memory size and speed, the number of terminals and diskettes that may be attached, and associated software. Each model incorporates a processor, keyboard, diskette drives, video display, and a communications function. Software available with the smaller models is supported by the larger versions.

The Datapoint 1130 has 16K bytes of RAM, referred to as "user memory" by Datapoint. The processor has a cycle time of 1.6 microseconds, can support up to two datastations and may be installed as a remote batch terminal. (Each datastation consists of a CRT and a keyboard.)

The Datapoint 1150 has 24K bytes of user memory and 4K bytes of ROM or system memory with a cycle time of 0.8 microseconds. This model also supports up to two datastations.

Four datastations may be accommodated with the Datapoint 1170 which has 48K bytes of user memory and 8K bytes of system memory. The four datastations can be attached, in any combination, either locally or remotely. Both the 1150 and the 1170 intelligent terminals provide concurrent communications processing in a real-time network. All three models are available with two, three, or four diskette drives.

The economical Datapoint 1500 terminal contains 32K bytes of user memory and 4K bytes of system memory; it supports a single datastation and provides two diskette drives. Each diskette provides a storage capacity of 0.25 million characters and is compatible with the IBM diskette. The diskette drives feature a "drive-in-use" warning light to alert the operator that the diskette is being accessed by the processor. The typewriter-style keyboard provides 76 key positions, including an 11-key numeric pad and five programmable function keys. If the operator wishes to check the status of the system, he may activate a debug feature by depressing a function key which displays status information on the video screen.

The Disk Operating System (DOS) is available with all four models. The operator may call utilities, using simple, English-like statements. DOS also supports sequential, random, and indexed sequential accessing methods. Software languages include COBOL, BASIC, RPG II and several special-purpose languages developed by Datapoint. These include DATAFORM, useful in preparing customized business forms; DATABUS, a special COBOL-type language; DATAPOLL, permitting communications to perform concurrently with local processing; MULTILINK and DATASHARE which allow terminals to be used in a multidropped telecommunications environment; and DSNET which permits access to distributed data files.

Standard hardware features on the Datapoint 1130, 1150, and 1500 terminals are similar to those of the Cassette 1100 series: a real-time clock, 14 registers, a 16-item push-pop stack, a one-microsecond interrupt facility, and high speed I/O channels. The larger 1170

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offers several additional improvements: memory indexing, double precision arithmetic, memory protect, 16 registers, and an extended instruction set including privileged instructions. See Table 1 for specifications.

Table 1. Datapoint Series 1100 and 1500 Processor Characteristics

	1130	1150	1170	1500
Processor				
Processor Model	2200	5500	5500	5500
Memory size (bytes)	16K	24K	48K	48K
Cycle speed (usec)	0.8	0.8	0.8	0.8
Datastations				
CRT/Keyboard (max)	2	2	4*	1
Peripherals				
Cassette drives (std)				
Diskette drives	1-4	1-4	1-4	1-2
Cartridge disk drives	—	—	—	—
7- or 9-track mag tape (max)	1	1	1	—
Printers (max)	2	2	2	1
Card reader (max)	1	1	1	—
Communications				
Control	IBM BSC	IBM BSC	IBM BSC	IBM BSC
Auto dial, auto answer	Yes	Yes	Yes	Yes
Asychronous/Sync	Yes	Yes	Yes	Yes
Multiport adapter	No	No	Yes	No
Software				
Operating system	DOS.C	DOS.C	DOS.C	DOS.H
DATABUS	Yes	Yes	Yes	Yes
DATAFORM	Yes	Yes	Yes	Yes
MULTIFORM	Yes	Yes	Yes	—
MULTILINK	—	Yes	Yes	—
DATASHARE	—	—	Yes	—
DATAPOLL	Yes	Yes	Yes	Yes
INFOSWITCH	—	—	Yes	—
BASIC	Yes	Yes	Yes	—
RPG II	Yes	Yes	Yes	—
COBOL	—	Execute only	Yes	—
RBT Emulators	Yes	Yes	Yes	Yes

*Each datastation can be attached either locally or remotely.

Emulators include emulation for the IBM 2780, IBM 3780, IBM 360/20, HASP, CDC 200, Univac DCT-2000, Burroughs TC500, Teletype ASR, and KSR terminals.

Other models in the product line include the Datapoint 2200, 4200, 5500, and 6600 processors. The 2200 was introduced in 1971 as an intelligent terminal. Soon afterwards it was upgraded to a small business system and a distributed processor. The 4200 Series is an expanded version of the 1100 Series hardware, using cartridge disks and the larger Datapoint processors: the 2200, the 5500 introduced in 1973, and the 6600 Series introduced in 1977.

The entire Datapoint product line can be used for intelligent data entry, local data processing or remote data processing. The selection of a particular version will depend upon whether diskettes or cartridge disks are required for storage and upon the number of terminals needed. The 2200 processor is the same as the 1130 processor with the exception that four datastations can be supported as well as cartridge disks. The 5500 processor is larger and faster than the 2200 processor. The instruction set of the 5500 is identical to that of the 1170 processor as is the size of the user memory and the system memory. Up to four simultaneous users are allowed on the 1170 processor while up to 16 datastations may be attached to the 5500 and 6600 processors.

The ANSI COBOL compiler and DATASHARE time sharing system are available on all processors with user memory of 48K bytes or more. These include the 1170; and the 4220, 5500, and 6600 processors.

Datapoint markets its systems through 34 direct sales offices in the United States. TRW Datacom International, Inc., in Los Angeles, is the exclusive international distributor of Datapoint systems. It provides maintenance, service, and support outside the United States through an international network of representatives. TRW Communications and its subsidiaries market the systems directly in Canada, Brazil, and Switzerland. Sales offices include Regnecentralen (Denmark and Holland), Oy Nokia Ab Electronik (Finland and Sweden), and Scanips (Norway and Austria); Ventek Ltd. handles sales in the British Isles. Other European sales offices include Matra S.A. (France), Gier Electronics (Germany), Sair Electronics (Belgium) and Encodex S.p.A. (Italy). In addition to these companies, CJK Company, Ltd., handles marketing in Japan, Control y Proceso Electronico SA in Mexico, Sigma Data in Australia, Information Systems, Ltd, in Israel, Computer Advances in South Africa, and Sistemas De Control C.A. in Equador. Applied Systems markets the Datapoint systems in the Philippines, Singapore, and Malaysia. Roughly 50 percent of Datapoint systems have been sold abroad.

COMPATIBILITY

Datapoint provides both hardware and software compatibility with most major communication techniques and a wide range of disciplines, such as binary synchronous. A variety of synchronous and asynchronous communication adapters can be plugged into the parallel data I/O bus. One is Datapoint's own parallel data communication adapter, which can connect to many peripheral devices available from other manufacturers.

The programmable nature of the Datapoint terminals theoretically enables them to simulate any terminal, and many customers have written their own specialty communication packages. Generally, however, terminal simulation is limited to the manufacturers' prewritten packages: IBM 2741; IBM 2780 Models 1, 2, 3, and 4; IBM 3780; Burroughs DCT 2000; Univac DCT 2000; CDC 200; and Teletype 33 ASR. The Datapoint software packages are upward compatible.

PERFORMANCE AND COMPETITIVE POSITION

The 1100 and 1500 intelligent terminals, together with the 2200 and 5500 small business systems, enable

the Datapoint user to set up a large distributed data processing network with a wide variety of computing capabilities. With the availability of the Datapoint computer-based dispersed processors, businesses have the advantage of complete data processing and data entry facilities in their field offices. Each processor can be geared to the load volume at a particular branch and each is capable of relatively easy expansion if business should grow.

Datapoint competes with Four-Phase, Sycor, Raytheon, and recently with IBM. The System/34 marketed by IBM's General Systems Division competes specifically with Datapoint's 1170. Both systems support local and remote attachments of CRT/keyboard units.

The main selling feature of the Datapoint intelligent terminals is the general-purpose processing capabilities of the programming languages from which the user can select the one best suited for his applications. Datapoint's success in implementing the distributed processing concept at user sites is based largely upon the extensive library of programming languages available for each model. Besides the languages designed by Datapoint for its processors, other languages supported by the systems include RPG II and BASIC. In addition, the 5500 processor-based models offer COBOL as an option. The competing units have a somewhat more limited range of programming languages which they can support.

USER REACTION

AUERBACH contacted three users of the Datapoint 1100s. A spokesman for an engineering company that has been using the 1100 for about a year and a half, said that his firm used the terminals on an around-the-clock basis and almost exclusively for local data entry. The 1100s are also used for remote batch applications as backup devices for the IBM System 360/20 at various locations throughout the United States and Canada. The spokesman indicated that the main advantage of the Datapoint processors is their low cost. Also, he said that the programming languages were easy to learn and the diskettes were fast for data entry and easy to store.

A disadvantage which this spokesman noted was in the 360/20 emulator. He said that several "bugs" had been in the emulator from the beginning and that this was related to communications line errors. He also mentioned that although hardware support was good, there were problems with software support. He thought that users should be kept up-to-date on new software releases, in addition to being told how to fix current problems. He stated that at present he is not notified of software changes on a current basis. Hardware support time was never more than a day's wait and usually the response was within an hour.

A major food processor has used the 1100s in its national distributed data processing network for about one year. The 19 processors located in the company's plants from coast-to-coast are used primarily as standalone devices, as batch input devices, and for communicating data to their IBM System 3 Model 15. Applications of the processors include inventory control and accounts payable. The company is in the final design stages for a standalone payroll system. This user felt that the main advantages of these processors are their sophisticated operating systems and their application languages. This company uses the RPG II language almost exclusively because it already had personnel who were trained in this language. The only Datapoint language which this company uses is DATAFORM, and the user representative expressed satisfaction with it.

Originally this user had four IBM 3741 Model 4s, but switched to the 1100 systems. The main reasons for the company's decision were the 1100's software, execution time, price, and performance. The IBM 3741 had no sort capabilities and was much more expensive than Datapoint 1100s. The representative said that the Datapoint processors had a lot of core storage and processing power which made them highly desirable. He said that the disadvantages with the Datapoint 1100s were that, initially, there were a lot of service problems with the equipment and that response times by Datapoint were poor. However, the response time is now much better and in the recent past no service calls were needed. This spokesman stated that with this system the user at the central site has complete control of all programs executed in the field. For example, if a numeric error is found in the master file at a plant in a different part of the country, the personnel there cannot fix the problem. However, personnel at the central site have the capability to correct the error after it is sent to them from the field site and to send the correction to the field location (within an hour in most cases).

A third user, a chemical manufacturer, has had two Datapoint 1100 systems for about one year. The processors are used in a number of applications: off-line data entry, communications to their mainframes (IBM 370/158), and in standalone applications. The processors are also used to a limited degree for word processing and text editing. Programming languages used by the company include BASIC, DATABUS, and DATAFORM.

Before deciding on the Datapoint systems, this user considered other products, including Sycor and IBM intelligent terminal systems. Datapoint was selected because it had a wide range of software available. The user's spokesman said that he could use the 1100s as standalone minicomputers or as communications devices with other Datapoint processors or mainframes in distributed processing or for off-line data entry. This spokesman also said that the Datapoint systems could be used to cut down timesharing costs. The Datapoint processors are used to write programs and then the information is sent to the mainframe computer for compilation, thus saving money in the editing costs involved in a timesharing system.

This user's spokesman found two disadvantages: first, he thought that the system's speed could be somewhat faster and second, that the CRT screen could be larger (25 lines). He also said that the training manuals could be improved by presenting all information in a more simple manner.

The spokesman said that the hardware maintenance is good. Problems with the system are solved within a few hours. However, he said that software support has been slow and inadequate. He suggested that one reason for this might be that Datapoint's technical support has not been able to keep pace with its rapid marketing growth. In many cases, Datapoint's systems engineers do not know the company's software well. The spokesman said that within the last year this situation has improved but it is still far from satisfactory.

The company is considering instituting a distributed system in the future. Its experience has generated considerable interest in Datapoint equipment and Datapoint stands well ahead of any other company for its selection of distributed data processing equipment.

CONFIGURATION GUIDE

The Datapoint 1100 Series consists of the following major components: a minicomputer, a standard typewriter keyboard, a 1,920-character CRT display, diskette drives, a card reader, a printer, and communications interfaces.

Minicomputer

The 1100 Series processor is an 8-bit parallel binary minicomputer with an 8-bit accumulator, 14 addressable registers, 50 instructions, a 16-item pushdown stack, a complete parallel I/O system and automatic power-up and power-fail restart. A virtual memory capability is provided, permitting overlaying of programs.

Keyboard/CRT

The integral keyboard contains 76 keys, including an 11-key numeric pad, shift/shift lock, and the standard ASCII alphanumeric character set. Also provided is a multiple key roll over feature that prevents lockout of subsequent keys as they are depressed in sequence and maximizes the typist's speed. Repetitive key entry is available under the DATAFORM software control; the operator may repeat the typing of a single character by depressing the character key longer than half a second. Five function keys are reserved on the right side of the keyboard to permit loading and starting the operating system.

The CRT uses the 5 x 7 dot matrix method of character generation. It has a 5 x 8 inch viewing area and can display 1920 characters arranged in 24 lines of 80 characters each. Up to 128 symbols may be defined by the user as the CRT character set. Controls include cursor positioning, line and frame erase, frame up and down, and blinking cursor. The display has a refresh rate of 60 frames per second and incorporates a character highlighting feature.

There are two versions of the operator datastation incorporating the keyboard/CRT components: the 3601 model is designated for use with the DATASHARE timesharing system; the 3610 model contains special cursor-control function keys to be used with the MULTIFORM data entry language. Several features incorporated into each datastation to aid the operator include playback of data entered, operator prompting, and an interactive capability. Software-generated security is available through a standard password control mechanism. Additional security control must be provided by the user with the aid of the DATASHARE language.

Diskette

The diskette magnetic storage device is available with all models. Each diskette drive holds one diskette and is capable of storing 0.25 million bytes with a transfer rate of approximately 31K bytes per second. All diskette operations are buffered and initiated under program control. Data is recorded in 128-byte sectors, which requires the diskette to be preformatted prior to system use.

Rotational speed is 360 rpm and the average latency time is 83-milliseconds. Access time is 10 milliseconds. Two 128-byte buffers are used to facilitate data transfer. Software formatted for the larger cartridge disk can be used on the smaller diskette. A utility allows Datapoint diskettes to be reformatted to be interchangeable with the IBM 3741 diskette.

Card Reader

A Datapoint card reader is available for remote batch or job entry applications. The card reader is fully buffered and reads 300 cards per minute. It is unusually tolerant of bent or damaged cards or out-of-punch registration.

Communications Interface

A synchronous communications adapter, several asynchronous adapters and a multifunction communications adapter are offered, as listed in Table 2.

The Multifunction Communications Adapter can function in one of three modes. In the SDLC mode, the line must be a full-duplex line using Synchronous Data Line Communications protocol. On a multipoint line, the adapter will transfer only the transmissions addressed to the terminal. In the BSC mode, the line

Table 2. Communications Adapters and Modems

Model Number	Name	Interface	Mode	Transmission Rate (bps)	Duplex
9400	Serial Data Adapter	EIA RS-232C-level signal	Async	110-4,800	Full, half
9401	Communications Adapter with Modem	Bell 103 equivalent	Async	110-300	Full
9402	Communications Adapter with Modem	Bell 202 equivalent	Async	300-1,200	Half
9403	High-Level Keyer	Telegraph lines	Async	110-300	—
9404	Synchronous Communications Adapter	Bell 201 or equivalent	Sync	2,000-4,800	Half
9420	Parallel Data Interface	Other mfrs peripherals	—	—	—
9462	Multiport Adapter	EIA RS-232C, for attachment of 8 interactive peripherals	Async	Up to 9,600	Full
9410	CCITT Interface, Asynchronous Adapter	For European and other communication networks, CCITT Recommendation V.24	Async	NA	NA
9481	Multifunction Communications Adapter	EIA RS-232	Sync	300-40K	Full, half
9408	DATASHARE Modem		Async	1,200 (transmit) 150 (receive)	Full
9409	DATASHARE Modem		Async	150 (transmit) 1,200 (receive)	Full

Notes:
—Variable
NA—Not available

must be a half-duplex line using Binary Synchronous Communications protocol. In the Program-Controlled mode, the line must be a half-duplex line using a user-defined protocol. The adapter will operate at speeds between 300 and 40K bits per second. RS-232C or CCITT V.24 interfaces and automatic dial-up are supported.

The Multifunction Communications Adapter is also used to attach up to four datastations to a communications line for remote operation on an 1170. The Synchronous Communications Adapter uses BSC protocol and can operate at up to 9600 bps. The interface standard is RS-232C.

Asynchronous Communications Adapters for all Bell modems are offered to operate on both full- and half-duplex lines. RS-232C and V.24 interfaces are supported.

Printers

Several types of printers along with variations in speed are available. The types include drum, belt, and serial. See Table 3 for a summary.

One or more console impact printers, such as the 9250 model, may be attached to the processor's I/O bus. Special features included with the line printers are buffering and a character selection option.

ATTACHED RESOURCE COMPUTER SYSTEM

The Attached Resource Computer System (ARC) permits linking the I/O bus of several Datapoint processors in an open ring, local network to enable each processor to access a common data base. The Datapoint units that can be attached in this configuration include the 1150, 1170, and 1500 systems; the 5500 and 6600 processors are also supported. A coaxial cable is used to connect adjacent processors, so that any communication between distant processors must be routed through the intermediate units. For this reason, the maximum distance allowed between adjacent processors is 2,000 feet.

There are two kinds of processors in an ARC configuration; an Applications Processor and a File Processor. The Applications Processor supports the operator

Table 3. Datapoint Printer Characteristics

Model Number	Type	Special Options	Speed	No. of Print Positions	Chars per Inch	Line Space (lines/inch)
9212	Belt	Upper/lower case	240 lpm	132	10	6
9213	Belt	Upper case only	340 lpm	132	10	6
9214	Belt	Upper/lower case	240 lpm	132	10	6
9231	Serial Matrix	Receive only	80 cps	132	10	6
9232	Serial Matrix		80 cps	132	10	6
9234	Serial Matrix	Dual tractor	80 cps	132	10	6
9250	Serial Servo	Console mounted	30 cps	132	10	6
9251	Serial Servo	Free standing	30 cps	132	10	6
9260	Drum	Upper case only	600 lpm	132	10	6 or 8
9261	Drum	Upper/lower case	600 lpm	132	10	6 or 8
9280	Drum	Upper case only	300 lpm	132	10	6
9281	Drum	Upper/lower case	300 lpm	132	10	6
9291	Belt	Parallel interface	60 lpm	120	10	6
9292	Belt	Serial interface	60 lpm	120	10	6
9294	Belt	Parallel interface	120 lpm	120	10	6

datastations and printers, performs the data entry and data communications functions, processes the application programs, and maintains local data bases. The File Processor, on the other hand, maintains the common ARC data base. Only the Datapoint 5500 and 6600 processors are assigned this function. All file access requests to the common ARC data base from an Applications Processor must be managed by the File Processor.

Besides the coaxial cable, the ARC system requires the installation of a Resource Interface Module (RIM) and a Hub. Attached to the rear of a processor, the RIM manages all data transmission between processors. The RIM is an 8-bit microprocessor developed by Datapoint. If a processor is added or deleted, the RIM automatically adjusts the system parameters to recognize the new processor interaction. The RIM is also responsible for providing buffers and error control for data and messages transmitted between processors.

A Hub is used to connect each RIM via the coaxial cable. There are two types of Hubs: a Passive Hub and an Active Hub. The Passive Hub distributes signals travelling over cables with a length of 200 feet or less. The Active Hub both distributes and amplifies the signal. The latter is used for cables more than 200 feet long.

Several other basic configuration rules apply:
(1) An Active Hub can support up to 8 RIMs
(2) A Passive Hub can support up to four RIMs
(3) A maximum of ten Active Hubs can be used, resulting in a maximum total cable length of four miles for one system
(4) A maximum of six RIMs may be attached to one processor
(5) An option for the ARC system is the Direct Channel Interface Option (DCIO); this allows the ARC system to interface directly to the byte multiplexor channel of an IBM System/360 or 370 mainframe. The DCIO is configured with a 6010 processor, a RIM, and a channel adapter.

SOFTWARE

Software available with the Datapoint 1100 Series comprises operating systems, programming languages, communication systems, and applications programs.

Operating System

The Disk Operating System (DOS) requiring 8K bytes of memory is available in several versions, depending upon the Datapoint model. DOS supports all of Datapoint's programming languages and applications; and features data storage optimization, file maintenance, file protection and recovery, and multi-tasking. DOS provides support for the following diskette access methods: sequential, random, hierarchical ISAM, and key-sequential.

Utility programs maintained are alphanumeric sorts, text editor, listing, data file purge and optimization, backup, and program linkage.

DATABUS. DATABUS is a high-level, COBOL-type, interpretive programming language. DATABUS programs are written under control of the Disk Operating System providing the programmer with all file handling capabilities available with DOS. Communications emulator packages may be used in conjunction with DATABUS, as can any data file created under DOS control.

This language offers five general statement types: data definition, arithmetic, character string handling, I/O, and program control specifications. Simple data formats can be specified for numeric, character, and string variables. Input/Output operations are provided to control the video display and to format printer output.

DATAFORM. DATAFORM is used to create screen formats for the control of data entry, allowing subroutines to be prepared comprising error checking, data entry operations, and printer output generation. The instruction set includes arithmetic, logical, file accessing, data manipulation, form formatting, and program control specification statements.

Available on the Datapoint 1500, DATAFORM provides a structured approach to screen formatting. Screen formats are created interactively. The steps required include defining the type of each field, identifying required fields; specifying justification; identifying fields to be highlighted on the screen; and identifying field formats, default specifications, and subroutine calls. Up to 26 different subroutines may be called by a screen form.

MULTIFORM. MULTIFORM is an enhanced version of DATAFORM and is available on the Datapoint 1130, 1150 and 1170 terminals. The significant difference between the two is that MULTIFORM allows the simultaneous access of created forms by multiple terminal operators.

The users can specify screen formats, identify fields, and generate subroutines to manipulate fields in exactly the same manner as with DATAFORM.

MULTILINK. MULTILINK is a real-time communications package which operates under DOS control. It allows Datapoint 5500 processor based terminals along a multidrop line to perform local processing tasks, including data entry, report generation, and the posting of inquiries to a host computer whenever data is not available from the local data base.

MULTILINK allows concurrent communications or printing with data entry by allowing two DATABUS programs to run concurrently. The DATABUS Master

program is used for data entry while the DATABUS Utility program is used for communications or print spooling. With the MULTILINK language extensions, either the Utility or Master program can transfer data to each other or to a host computer. The MULTILINK enhancements to the DATABUS language include the following instructions: to send data to a host computer or the other program, to receive data from a host computer or the other program, to test the condition of the transmission, or to clear a posted transmission.

A MULTILINK system in a network controlled by a host computer may have access not only to its own local data base but also to the host computer's data base. The host computer can also poll and access the other distributed data bases on the network thus providing complete access to all dispersed data.

Software-programmed, switch selectable transmission speeds from 1200 bps to 9600 bps can be obtained with the MULTILINK software, although higher transmission rates can be achieved using a programmable modem from Datapoint. MULTILINK currently supports IBM 3770 batch/inquiry terminal emulation. Future releases will include Burroughs, Honeywell Information Systems, and Univac line handlers.

DSNET. DSNET is a remote file processor.

DATASHARE. DATASHARE is an interpretive language which extends the commands available with the DATABUS language. DATASHARE is designed to permit up to four user programs, written in either DATABUS, RPG II, COBOL or BASIC, to be executed simultaneously in any combination of remote or local processing. Distributive data processing is accomplished by incorporating MULTILINK, DSNET, and a remote batch emulator.

DATASHARE is available only on the 1170 processor and requires four diskettes of storage to operate. Communications may be configured Datapoint-to-Datapoint or Datapoint-to-mainframe. A typical network involves a hierarchical structure with terminals linked in a combination of the two arrangements.

DATAPOLL. DATAPOLL is designed to permit point-to-point communications between Datapoint terminals, and is available with all models. Data communications can occur concurrently with local processing at each network point. A central processor or mainframe can poll each terminal in the network and retrieve data from local data files.

The Datapoint 1500 has two communications channels, one of which is assigned to a communications adapter. Communications can take place in one of two ways under DATAPOLL, the terminal can be polled through the automatic answering facility or it can be initiated to run during off-hours in an unattended mode. Automatic recovery techniques facilitate restarting transmission when an error is detected.

INFOSWITCH. INFOSWITCH is a turnkey operation which is designed to provide a computer-operated telephone switching and billing system. This operation can be hooked up to existing Centrex or PBX systems and requires a terminal configuration with a minimum of 48K bytes of memory, a cartridge disk, a printer, and a real-time controller.

The benefits of INFOSWITCH include reduced telephone line costs and fewer unnecessary long-distance calls. This is accomplished through comprehensive telephone traffic analysis and accumulated usage statistics. Information that is logged on each long-distance call includes the date, the time, the caller's identity, the destination, and the duration of the call.

Emulator Programs. Terminal emulators are available for the IBM 2780 and 2741, as well as for CDC 200, Univac DCT 2000, and teletypewriters. The emulators permit the 1100 to act as a plug-to-plug replacement for the corresponding terminal. Datapoint states that no hardware or software changes are required for any of its emulators. Host computer programs that refer to peripherals not on the 1100, however, will have to be altered; or the 1100 can switch the data to another peripheral. For example, instead of punching data in cards, it can be loaded on a cassette.

The UNI 2741A program requires 4K bytes of memory; it provides complete 2741 compatibility including EBCDIC transmission over a synchronous modem. The EM 2780 emulator transmits and receives 80-column card images using IBM's Binary Synchronous Communication (BSC) technique. It emulates all modes and features of the IBM 2780 Models 1, 2, 3, and 4 terminals. The package requires 4K bytes of memory, the Synchronous Communication Adapter (2200-404), and a Bell 201-compatible modem.

The IBM 3780 emulator can be used for remote job entry to a computer or for communication with another IBM 3780. This emulator uses the BSC line discipline with either the EBCDIC or ASCII transmission code. The HASP system is an automatic spooling, priority scheduling system. While operating in conjunction with IBM 360 or 370 operating systems, it operates an unlimited number of peripherals simultaneously with normal job execution; thus it performs the functions normally associated with off-line support computers.

Datapoint's CDC 200 emulator performs all tasks that the CDC 200 does. In addition, it can convert code from IBM 026 or 029 card decks (normally done on a CDC 6000) and data can enter via cassette loading.

The standard Univac DCT 2000 emulator includes many of Univac's extra-cost options, as well as standard features — unattended answering, off-line listing, and so on. Like the CDC 200, the DCT 2000 is card-oriented, while Datapoint's system alternatively provides the convenience of cassettes.

Other emulator programs include a Teletype Model 33 ASR with modem. NLN COM4 is a communications package that allows an 1100 to transmit and receive cassette files using auto dial and auto answer.

Scribe. A Scribe is a text processing and printing utility which can be used with the general-purpose text editor (GEDIT) to provide a complete automatic typing/word processing system. The typist can either format the text on the screen as it is to be printed or can type free form, imbedding printing control symbols. In either case, data on the screen can be checked and corrected before printing a final copy.

Diagnostics. Diagnostic programs include testers for combined memory and tape endurance printer, parallel interface display, memory keyboard processor, and others.

DATACCOUNTANT. DATACCOUNTANT is a computer system designed specifically for independent accountants; it consists of the 1100 system, a printing unit, a disk storage unit, and a library of Datapoint-designed automated accounting programs. The structure of these is such that a wide variety of options and formats are available to the user, yet no programming capability is necessary for their utilization. Application systems in the DATACCOUNTANT software library include: Client Accounting System, Payroll, Professional Time Accounting, Word Processing, and Accounting Utilities.

Simplicity of operation is made possible by the "menu" sequences displayed on the 1100's video screen and the English-language dialogues it permits between computer and operator. During client set-up, the operator specifies in plain English what type of processing is to be done and what type of reports are to be generated. The DATACCOUNTANT system retains this information and uses it to adjust to the processing requirements of each client. An error-checking capability is also included with DATACCOUNTANT. When an operator makes an error, the system automatically flags it and displays a message indicating the most likely correction paths to take.

Software Available from Other Vendors

Standardized packages and software services for the 1100 systems are available from a number of independent software houses. Among these are Bristol Information Systems (Fall River, MA), Computerm (Bellevue, WA), Dialogue Systems (Richardson, TX), Diana M. Engel (Washington, DC), F & S Systems (Framingham, MA), Goal Systems Corp (Westport, CT), Jammar (San Bruno, CA), and PBS Systems (Bellevue, WA). Packages currently offered include Accounts Receivable, Perpetual Inventory, Sales Analysis, Payroll, Accounts Payable, General Ledger, Mailing List Maintenance, Medical Billing, and a variety of utility routines (sort, etc.) extending Datapoint's own offerings. Many of these programs require 8K words or less of memory. Even though they were originally written for the 2200 processor-based systems, they will run on the 5500 processor-based systems without alteration. Datapoint does not support these packages; it only provides a list of the independents it knows about. As Datapoint delivers more terminals and small business systems, more independent software should be offered.

MAINTENANCE

In the United States, Datapoint provides maintenance support through a staff of service engineers in 50 service centers located throughout the country. In addition, the company has 24-hour toll-free WATS lines to a control center in Texas that promises a firm time commitment for customer service within one hour. Replacement parts are stocked at all major cities. Datapoint quotes from four to six hours average response time for user maintenance calls. The lease price does not include maintenance service, and each user must negotiate a maintenance contract with Datapoint. These contracts can be on an 8-hour, 24-hour, or per-call basis (prices quoted in the price data chart are for 8-hour contract). The contracts generally cover units located within 15 miles of a Datapoint maintenance service area. Emergency maintenance service can be prearranged.

Installation of new systems takes an average of two hours per system. The installation charge is in addition to the purchase or lease price. New systems carry a 90-day warranty.

Datapoint also maintains a Datapoint training center at its manufacturing facilities in San Antonio, Texas, where a series of comprehensive courses acquaints potential customers and new customers with the product line. Some customers with purchased systems have been trained to do their own maintenance work.

Outside of the United States, Matra Engins, Regnecentralen, and the other companies mentioned earlier are responsible for maintenance in their territories. Companies marketing the Datapoint system were chosen partly because they have marketed other peripheral systems and thus already have established service networks. Regnecentralen, for instance, has a particularly dense network of sales and service centers in Denmark and West Germany, from which it has serviced RC 3600 peripheral processing systems. Matra is also well-represented in France and Belgium. All distributors outside the United States are appointed by TRW, Inc, in Los Angeles, under the master distributorship agreement mentioned previously.

PRICE DATA

Model	Description	Lease 1-Yr* (Maint not Incl) $	Purchase Price $	Maint $
	Datapoint 1130			
1131	Datapoint 1130, 16K Memory, 1 Diskette Drive	274	12,880	45
1132	Datapoint 1130, 16K Memory, 2 Diskette Drives	309	13,480	60
1133	Datapoint 1130, 16K Memory, 3 Diskette Drives	359	14,080	75
1134	Datapoint 1130, 16K Memory, 4 Diskette Drives	409	14,680	90
	Datapoint 1150			
1152	Datapoint 1150, 24K Memory, 2 Diskette Drives	436	14,480	65
1153	Datapoint 1150, 24K Memory, 3 Diskette Drives	479	15,080	80
1154	Datapoint 1150, 24K Memory, 4 Diskette Drives	522	15,680	95
	Datapoint 1500			
1500	Datapoint 1500, 48K Memory, 2 Diskette Drives	125	5,950	62
	Datapoint 1170			
1172	Datapoint 1170, 48K Memory, 2 Diskette Drives	416	15,980	125
1173	Datapoint 1170, 48K Memory, 3 Diskette Drives	444	16,580	125
1174	Datapoint 1170, 48K Memory, 4 Diskette Drives	472	17,180	125
	Datastations (Display/Keyboard)			
3600	Datastation (1170 only)	87	1,950	10
3610	Multiform Datastation	87	1,950	10
	Mass Storage			
	Disks			
9350/1	Cartridge Disk Controller/Drive Console, Freestanding	329	9,800	65
9352/3	Cartridge Disk Controller/Dual Drive Console, Freestanding	526	13,600	76
9354	Cartridge Single Disk Drive Extension Unit	278	8,500	40
9355	Removable Cartridge Dual Disk Drive Extension Unit	475	12,900	57
9356	Fixed Cartridge Dual Disk Drive Extension Unit	200	6,000	40
9357/8	Cartridge Disk Controller/Drive (Freestanding/Console)	361	12,500	60
9359	4K Controller Kit		2,800	
9367/8	Dual Disk; 4K Controller, 1 Removable and 1 Fixed Disk Drive, Console of Freestanding	470	16,300	70
9369	Dual Disk Extension Only, (No Controller) Freestanding	196	6,863	55
9370/3	Mass Storage Controller and Drive, Freestanding/Console Mounted	581	19,872	130
9371	Mass Storage Drive Extension for 9370	244	8,352	95
9381/5	Diskette Controller with 1 drive, Console Mounted/ Freestanding	95	3,800	28
9382/6	Diskette Controller with 2 drives, Console Mounted/ Freestanding	123	4,400	44
9383/7	Diskette Controller with 3 drives, Console Mounted/ Freestanding	151	5,000	60
9384/8	Diskette Controller with 4 drives, Console Mounted/ Freestanding	179	5,600	76
	Input/Output			
9504	Card Reader (80 col, 300 cpm)	125	5,000	35
9250/1	Servo Printer (Console/Freestanding)	223	5,430	40
9232	Freedom Printer (80 cps, parallel interface, 60 Hz)	141	3,950	30
9280	300-lpm Printer (64-char/single channel vertical form control)	470	12,600	120
9281	300-lpm Printer (96-char/single channel vertical form control)	549	14,475	135
9260	600-lpm Printer (64-char/single channel vertical form control)	635	16,380	180
9261	600-lpm Printer (96-char/single channel vertival form control)	738	18,820	200
9212	Belt Printer (132 col, 120-240 lpm)	325	8,640	65
9214	Belt Printer (132 col, 230-240 lpm)	410	11,880	80
9291	Belt Printer (120 cps, parallel interface, 60 Hz)	219	5,500	40
9292	Belt Printer (120 cps, serial interface)	165	5,500	40
9294	Belt Printer (240 cps, parallel interface)	246	7,300	55
9550/1	Tape Transport (9-track, console/freestanding)	295	8,500	50
9552/3	Tape Transport (7-track, console/freestanding)	295	8,500	50
9580/1	Tape Transport (9-track, 1,600 bpi, console/freestanding)	398	12,200	60
9554	Tape Transport, 10-1/2 in. reel, 800 bpi, 9-track	360	11,500	60
9555	Tape Transport, 10-1/2 in. reel, 800 bpi, 7-track	360	11,500	60
9583	Tape Transport, 10-1/2 in. reel, 1,600 bpi, 9-track	405	15,500	75
	Data Communications			
9400	Asynchronous Communications Adapter — EIA Interface	39	910	11
9401/2	Asynchronous Communications Adapter (103-202 compatible modem)	61	1,500	15
9403	Asynchronous Communications Adapter (telegraph high level keyer interface)	61	1,500	15

PRICE DATA (Cont.)

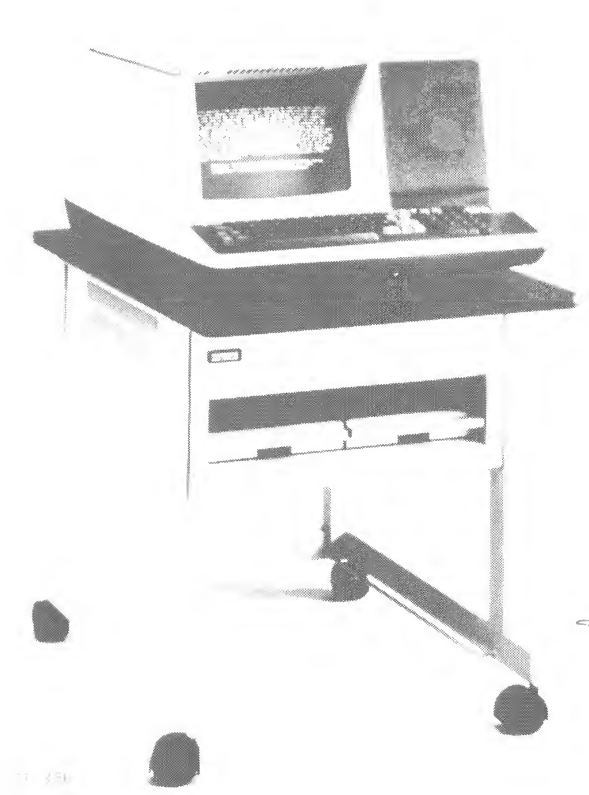
Model	Description	Lease 1-Yr* (Maint not Incl) $	Purchase Price $	Maint $
9404	Synchronous Communications Adapter (EIA interface, without internal clock)	39	910	11
9481	Multifunction Communications Adapter	78	1,911	25
9420	Parallel Communications Adapter (logic interface)	35	750	11
9450	Multiple Communications Adapter Card	113	3,600	10
9455	Multiple Communications Adapter Housing	86	2,300	105
9451	Asynchronous Communications Adapter (EIA interface for use with 9450 and 9455)	38	710	11
9452/3	Asynchronous Communications Adapter (103/202 modem compatible for use with 9450 and 9455)	51/57	1,300	11
9454	Asynchronous Communications Adapter (telegraph high-level keyer interface for use with 9450)	57	1,023	11
9456	Synchronous Communications Adapter (EIA interface for use with 9450 and 9455)	37	790	11
9457	IBM Selectric Interface (for use in 9450 and 9455)	34	400	10
9459	Parallel Communications Adapter (logic interface for use with 9450)	34	567	10
9462	Multiport Communications Adapter (with data set ready signal provided)	66	1,500	15
9408/9	DATASHARE Modem	38	790	15

*2-, 3-, and 5-year plans are also available as well as a short-term rental plan.

	SOFTWARE	One-Year Monthly Lease $	Purchase License Fee $	One-Time License Fee $	Monthly Maint Fee $	One-Time Instal Charge $
	DATACCOUNTANT					
40194	Client Accounting System	100	4,400	1,950	20	1,010
40195	Professional Time Reporting System	50	2,200	975	20	1,010
40196	Payroll Processing System	75	3,300	1,463	20	1,010
	Languages					
20329	COBOL	65	2,500	—	20	—

DIGITAL EQUIPMENT CORP

DECstation 78



OVERVIEW

Digital Equipment Corporation, a major manufacturer and supplier of computer systems, peripherals, and display terminals, has developed an intelligent, diskette-based terminal system, the DECstation 78, for OEM customers and end users.

The DECstation 78 features an LSI version of Digital's PDP-8 minicomputer (containing 32K-bytes of Random Access Memory) integrated into a VT-78 video terminal. The VT-78 employs many of the same features of the DECscope terminal family, including: a 1920-character display, complete upper- and lower-case ASCII character set, alphabetic and numeric keypads, 33 special symbols and 19 user-defined function keys. The VT-78 video processor also has standard features that are optional on other Digital PDP-8 computer systems. Among these are: a real time clock, asynchronous communication, disk and high-speed data interfaces, and electronic program injection. Industry-compatible RX78 dual diskette drives store up to 256K 8-bit bytes or 128K 12-bit words, and provide high-speed I/O functions as well as basic program loading capabilities. A variety of plug-in peripheral devices, including hard-copy terminals and printers, are available for the DECstation 78.

Designed to operate either in an on-line mode as part of a larger computer system, or off-line as a stand-alone unit, the DECstation 78 is well suited for business, data communications, engineering and word processing applications. Software available for the DECstation 78 includes the OS/78 operating system with both BASIC and FORTRAN IV compilers, editor, PAL-8 Assembler, and utilities; and RTS/8, Digital's real-time monitor, which permits multi-tasking and real time interfacing.

Digital Equipment Corp. is the world's largest manufacturer of minicomputers and in addition, is a major producer of small-, medium-, and large-scale computer systems, peripherals, software packages, and support services.

PERFORMANCE AND COMPETITIVE POSITION

The DECstation 78 is a hybrid intelligent terminal system designed for a variety of distributed processing and word processing applications. — Hybrid in the sense that it combines the power and intelligence of Digital's popular PDP-8 minicomputer with the modularity of Digital's terminal components. DECstation 78 terminal components are fully integrated, both mechanically and electronically. By incorporating a single-chip LSI version of the PDP-8 minicomputer into a CRT display terminal and adding simple cable connectors for peripheral attachments, the DECstation 78 can be easily configured as an integral element in an on-line network or as a stand-alone desk-top computer, intelligent terminal, or word processing system.

In an on-line environment, the DECstation 78 can function as a network or remote data acquisition minicomputer, a timesharing terminal with local storage facilities, or as a satellite system. Configured as a word processing system, the DECstation will manage text entry and editing functions in either a stand-alone or shared-logic network. As such, the DECstation is both hardware and

HEADQUARTERS

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software compatible with Digital's PDP-11 computer system. (See AUERBACH DEC WS/WT 78 Word Processing Report 304.3451.800.)

The basic DECstation 78 features an electronic program injection capsule which enables programs to be automatically loaded into memory and executed by depressing the start switch. The program capsules may be supplied by Digital or customized by an OEM for specific applications. With this feature, program loading via the conventional diskette system is eliminated. For those users requiring more storage capacity, the optional dual diskette drive provides random-access file functions, 128K of 12-bit storage or 256-K of 8-bit storage, and program loading into main memory. To complement the processing capabilities of the DECstation 78, Digital has developed three software systems which are completely compatible with the PDP-8 minicomputer systems. OS/78 is a set of program development and calculation routines designed to support both batch and interactive applications programs. The Digital RTS/8 real-time monitor provides multitasking and real-time interfacing, features which are normally found only on larger systems. DECnet 8 is a software package which permits intercomputer communications.

From a competitive standpoint, the DECstation 78 falls in between the intelligent terminal and minicomputer system categories. Digital's approach is to market the DECstation to OEM and end users alike in both these areas. Two of Digital's major competitors (Burroughs and Inforex) offer systems that can operate either as intelligent terminal systems or small business computers. The Burroughs TC-5115 Intelligent Terminal System features a 28Kb memory, 256-character Self-Scan display, 60 cps serial impact printer, and dual mini-disk drives with 243Kb storage housed in an integral desk unit. Data communications include IBM bisync, Burroughs BDLC, and IBM 2260/2740 protocols. Operating on-line, the TC-5115 is configured with single or dual communications channels to Burroughs or other vendor host computer systems. Off-line, the TC-5115 can perform many of the same functions as the DECstation 78. The Inforex System 7000 Intelligent Terminal is a microprocessor-based distributed processing system built around the Data General Nova 1200. With 64Kb of memory, 10 megabyte disk drives, 45 cps terminal printer, 600 lpm line printer and 1,920-character CRT display, the Inforex 7000 is comparable in terms of performance with the DECstation. Price-wise, the Inforex 7000 costs $17,000 to $50,000, depending on the configuration. — twice as expensive as the DECstation 78.

The modular design, nominal cost and PDP-8 compatibility of the DECstation 78 are factors that Digital is sure will prove attractive to its 40,000+ PDP-8 customer base; as well as prospective distributed and word processing users.

USER CASE HISTORY

There is no User Case History to date due to the newness of the DECstation 78.

SYSTEM DESIGN

The DECstation 78 consists of an integrated VT-78 video-processor and RX78 dual-diskette drive and OS/78 software.

The VT-78 video processor contains an LSI version of the PDP-8 minicomputer with 32K bytes of Random Access Memory (RAM) and a DECscope-style CRT. The CRT features a 1,920- character display format, with characters generated on a 7x7 dot matrix. Cursor control, scrolling, and hold screen functions are identical to those of the DECscope video display terminals. Individual characters, lines, or the entire screen can be erased by giving simple commands. The VT-78 keyboard generates 96 standard ASCII upper- and lower-case alphabetic, numeric, and symbolic characters, plus 32 special graphic characters. A 19-key user-defined special function pad is also provided. The standard keyboard is designed in the familiar typewriter format; an optional keyboard is available in a word processing format. An I/O connection panel on the back of the VT-78 video processor contains five plug-in ports to accommodate communications, peripheral, disk, and electronic program injection capsule interfaces; only one cable between each peripheral and the processor is required.

The RX78 dual-diskette drive stores up to 256K 8-bit bytes or 128K 12-bit words per drive. This is the equivalent of 100 pages of typewriter text. Rotational speed is 360 rpm, with an average access time of 483 milliseconds. The RX78 accepts pre-formatted industry compatible diskettes.

The OS/78 software supplied with the DECstation 78 is a disk-resident monitor that permits program development, data storage, and numeric analyses to be performed on the DECstation. Both BASIC and FORTRAN IV compilers are provided, as well as the PAL-8 Assembler, utility sub-routines, and command language. DECstation 78 housekeeping functions can be performed by simple one-word instructions.

A variety of Digital peripheral devices can be configured with the DECstation 78: DECprinter/DECwriter/terminal printers and DECscope/DECgraphic video display terminals.

Table 1 provides a summary of system specifications.

COMPATIBILITY

Featuring PDP-8 intelligence, the DECstation 78 is completely compatible with the entire DEC computer product line and can be easily adapted to interface with other major computer systems. Peripherals, which can be plug attached via a parallel I/O port on the VT-78 control unit, include the DECwriter/DECprinter terminals and DECscope/DECgraphic display systems.

The DECstation 78 is software compatible with conventional PDP-8 programs. As such, the sytem is able to utilize a variety of programs from Digital Equipment's library, or those available through DECUS (Digital Equipment Computer Users Society).

Table 1. Digital Equipment DECstation 78: Specifications

Control Processor	
Word Size (bits)	12
Cycle Time, usec	3.6
Memory Size (KB)	32
I/O Channels	5
Languages Supported	BASIC, FORTRAN IV; Assembler
Software Provided	OS/78; DECnet 8; RTS/8
Display Unit	
Screen Size (char)	1,920
Char per Line	80
Lines per Display	24
Paging Capacity	Yes
Char Generation	7x7 dot matrix
Char Set (char)	96 ASCII
Features	Direct Cursor Address; 19-Key function pad
Data Communications	
Line Facilities	Voiceband
Line Speed (bps)	50-19, 200
Line Mode	HDX; FDX
Line Code	ASCII
Synchronization	Async
Interface	20 MA loop or RS-232-C
Peripherals	
Diskette Drive:	
Access Time (msec)	483
Transfer Rate (usec)	23
Storage Capacity (KB)	128/256
Terminal Printer:	
Method	Serial Impact
Max Print Line (char)	132
Speed (cps)	10/15/30: 45; 180
Compatibility	
Computer System	DEC PDP-8/11; any ASCII-supported
Terminals	TTY
First Delivery	Sept 1977

DATA COMMUNICATIONS

Two serial EIA RS-232-C interface ports located on the back of the VT-78 provide for asynchronous communication in half- or full-duplex modes, at speeds ranging from 50 to 19,200 bps.

The parallel I/O port, designed to accommodate terminal printers and custom interfacing, incorporates a standard current loop interface that provides bi-directional 12-bit transfers at rates up to 15K words per second.

MAINTENANCE

Digital Equipment's field service organization consists of over 2,000 personnel in service offices and repair depots located throughout the world. For the DEC Station 78, Digital Equipment offers a number of comprehensive maintenance plans:

- On-Site Contract Service with prime shift 8-hour coverage, 5-days per week.
- On-Site Per Call Service with time and material charges.
- On-Site User Maintenance Service with defective module exchange.
- Depot Maintenance with mailer return.

Digital Equipment provides a 90-day, on-site warranty for the end user, after which the latter selects the type of maintenance plan that best suits his needs. The OEM warranty consists of a 30-day replacement warranty, including diagnostic software to aid in subsequent trouble-shooting.

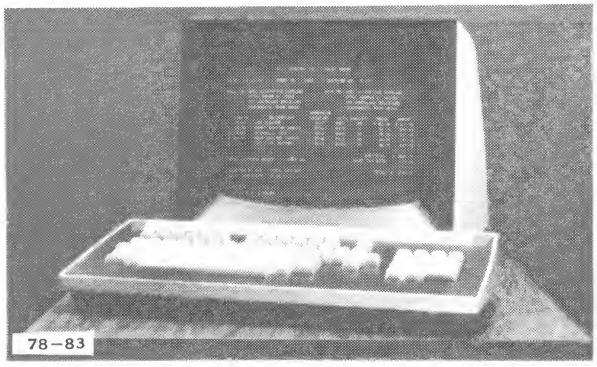
PRICE DATA

The DECstation 78 is available on a purchase only basis for OEM and end users. Quantity discounts are available from Digital Equipment. Prices quoted are F.O.B. Maynard MA.

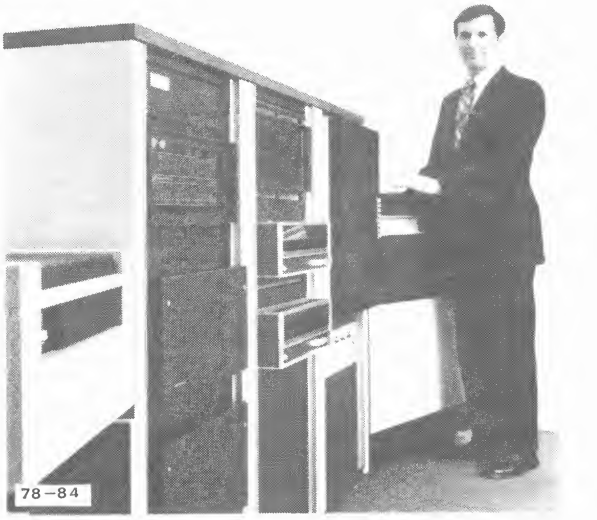
Model No.	Description	Purchase Price $	Maint.(1) Charge $	Service Install. $
78/40-A	VT-78 Video Processor with RX-78 Floppy Disk	7,895	68	—
78/40-B	VT-78 Video Processor, RX-78 Floppy Disk, and OS/78 Software	7,995	68	—
78/40-C	VT-78 Video Processor, RX-78 Floppy Disk, and Mini-Desk option	8,145	68	—
78/40-D	VT-78 Video Processor, RX-78 Floppy Disk, OS/78 Software, and Mini-Desk option	8,245	68	—
78/60-C	VT-78 Video Processor, 2 - RX-78 Floppy Disks, and Mini-Desk option	12,445	101	—
78/60-D	VT-78 Video Processor, 2 - RX-78 Floppy Disks, OS/78 Software, and Mini-Desk option	12,545	101	—
	Options			
BC03M-25	Null Modem Cable	60	—	—
BC05D-10	EIA RS232C Cable	94	—	—
H978-AA, AB	VT-78 Mini-Desk	250	(2)	(2)
H978-AC/AD	VT-78 Mini-Desk w/Panels	400	(2)	(2)
LA180-E	DECwriter I	3,770	55	50
LA36-H	DECwriter II	2,580	19	50
LA78-P	DECprinter	3,300	50	50
LQP78-P	Console Printer	3,995	(2)	(2)
VT52-A	DECscope Video Terminal	2,200	20	50
VT55-E	DECgraphic Video Terminal	2,750	25	50
QF020-XY	OS/78 Operating System	550	—	—
QF022-AY	DEC Net Software	1,400	—	—
QF680-XY	RTS-78 Software	900	—	—

Notes:
(1) Maintenance charges are in addition to the Purchase Price.
(2) Contact Digital Equipment for pricing information.

FOUR-PHASE SYSTEMS
System IV Intelligent Terminals



Represented to the right is the powerful processor of the top-of-the-line System IV/90. Above is the compact System IV/30 with a single display/keyboard workstation.



Faster CPU speeds, an expanded instruction set, and up to 192K bytes of memory are featured in Four-Phase's new System IV/90. Designed for large-volume distributed processing sites, the new top-of-the-line processor supports up to 32 video displays with instruction execution speeds from 2 to 8 times faster than those previously available.

OVERVIEW

A typical Four-Phase System IV Intelligent Terminal consists of a cluster of CRT display/keyboard units, printers, and mass storage media controlled by a minicomputer. The processor, with a 24-bit word and a 2-microsecond cycle time, is built by Four-Phase. Each model supports one communications line for attachment to a remote host computer.

The System IV terminal systems are designed to accommodate both data entry/data editing/data validating functions and distributed processing functions. The latter includes local file maintenance and communications interface with a remote host. The cost of the necessary software to perform the functions is included in the price of the hardware.

Systems IV/40, IV/50, IV/70, and IV/90 are designed for users who need multiple data entry stations capable also of performing data processing functions. Up to 32 display/keyboards and 32 character printers constitutes a single System IV system. Extensive mass storage can be added to such a system to include up to 67.5M bytes of disk capacity, 354K bytes of diskette capacity, 2.5M bytes of cartridge capacity, and four magnetic tape drives. A card reader can also be attached. Such systems are employed where either high volume or multiple workstations and local data processing are a systems requirement.

In contrast, Systems IV/30 and IV/55 are designed for use in locations requiring only one or two data entry/display stations, or one data entry/display station and one printer. The Systems IV/30 includes one cartridge disk drive with an on-line capacity of 354K bytes. The System IV/55 includes one diskette drive with an on-line capacity of 254K bytes. Such systems are ideal for data entry workstations and host-driven report printing. Usually, the host performs almost all of the data processing functions.

Asynchronous transmissions of 2400 bps and synchronous transmissions of 9600 bps are supported by the System IV. Synchronous transmissions use BSC protocol; or, for the IV/90 SDLC protocol is optional. Direct communications with an IBM System/360 and 370 is supported along with emulation. Four-Phase-supplied emulation software include: emulation of IBM 2780/3780, 2260/2848, and 3270; data entry support packages; and distributed processing packages.

Four-Phase is considered by many to be the pioneer in the field of distributed processing systems. The distributed processing approach is intended to have the terminal system assume a limited amount of the central host's tasks, especially those relating to data entry. The System IVs,

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therefore, were given sufficient mass storage and software support to perform data entry, data editing, limited file maintenance, and remote host communications support. The first System IV delivery was the System IV/70 in 1972. This was followed by delivery of the System IV/40 in 1973, the IV/50, IV/30, and IV/55 in 1976 and the IV/90 in 1977. To date, over 5,000 systems have been delivered.

PERFORMANCE AND COMPETITIVE POSITION

The over five thousand installed systems enable Four-Phase to enjoy the success of a pioneer in distributing data processing from host computers to programmable terminals; terminals providing multiple data workstations. Now however, the competition is formidable. Datapoint with its 1100 family of intelligent terminals, Raytheon with its PTS/1200, and Sycor with its 340, 350 and 440 are among the marketers competing for the cluster-terminal market. Lately IBM has directed significant emphasis to this segment of the EDP market. While many of the latest Data Processing Division (DPD) enhancements to IBM's 3790 are seemingly directed at the Four-Phase market, the Systems/34, marketed by IBM General Systems Division (GSD) may offer more serious competition. Only the System IV/90 processor, which is two to eight times faster than the remainder of the System IV family can be considered competitive with the System/34 processor. GSD, unburdened with DPD's unswerving commitment to centralized data processing, has fashioned the System 34's capabilities more in tune with the distributed data processing philosophy.

Four-Phase is, perhaps, the most tight-lipped vendor in the intelligent terminal market and the only significant vendor that refuses to list component prices. Only packaged systems prices are published. However, the introduction of the System IV/90 last summer appears to be a forerunner of terminals with ever-increasing processing capabilities — a trend that makes the intelligent terminal a misnomer. Such powerful terminals are minicomputers with multiple workstations and communications facilities. While the number of workstations attachable to a System IV/ will most likely not exceed the 32 offered on the System IV/70 and IV/90, the support of multiple remote workstations is a most probable future enhancement to the Four-Phase product line.

CONFIGURATION GUIDE

The six packaged models offered can be classified into three basic configurations. The IV/30 and IV/55 constitute one classification offering the 2-microsecond processor with 24K bytes of memory. Both models include one display/keyboard as standard and either an asynchronous or a BSC communications controller. Each model optionally supports attachment of either a second display/keyboard or a printer. The IV/30 includes cartridge disk mass storage with a 2.5M byte capacity and the IV/55 includes diskette storage with a capacity of 354K bytes.

The IV/40, 50 and 70 constitute the second classification. All three models offer the 2-microsecond processor with 24K bytes of memory as standard and expandable up to 96K bytes. All models optionally support one card reader (300 or 600 cpm) and include a BSC communications controller. The maximum number of display/keyboards and character printers attachable varies with each model. The IV/40 allows up to 16 display/keyboards and up to 16 printers; the IV/50 allows up to 24 of each; and the IV/70, up to 32 of each. While the IV/40 does not support disk, the IV/50 and IV/70 support from one to four disks, with each disk having a capacity of 67.5M bytes. A 50M byte-capacity disk is available for the IV/70. All models support one cartridge disk drive of 2.5M byte capacity. The IV/70 will support up to four magnetic tape drives.

The IV/90 constitutes the third classification. The IV/90 supports the attachment configurations allowed on the IV/70, namely: up to 32 display/keyboards, up to 32 character printers, one to four drives of disk and magnetic tape, one diskette drive, one cartridge disk drive, and one card reader. The IV/90, however, provides 96K bytes of memory as standard, and is expandable to 192K bytes. Although the processor is the same 2-microsecond processor, the 800 nanosecond memory mapping feature, necessary for addressing the second 96K bytes of memory, imparts an effective throughput that is two to eight times faster than the basic 2-microsecond processor. Additionally, the IV/90 communications controller supports either asynchronous BSC or SDLC protocols.

For all System IV models, line printers can be substituted for character printers. The number of line printers allowed is dependent on the line printers speed. At speeds of 1800 lines per minute, each model, except the IV/30 and 55, will support two line printers.

The systems configurations are summarized in Table 1.

COMMUNICATIONS INTERFACE

The Systems IV/70 and IV/90 have sufficient software and hardware support to operate as standalone data processing systems. The two models also support local attachment to IBM Systems/360 and 370. A channel-to-channel adapter is required for attachment to the System IVs communications port.

The Asynchronous Data Set Communications Controller will permit asynchronous transmission of up to 2400 bps using any 9- or 11-bit code. The Binary Synchronous Data Set Communications Controller will permit synchronous transmission up to 9600 bps using any 7- or 8-bit code. Both controllers accommodate half- or full-duplex lines and offer an EIA RS-232C interface.

The System IV/90 supports a third controller which includes a 16K byte processor. The Intelligent Communications Controller will support both BSC and SDLC protocols.

SOFTWARE

Network Transaction Processing (NTP), Data IV, STARTER, VISION, and ForeWord are among the soft-

Table 1. Four-Phase System IV Systems Configuration

Model	IV/30	IV/55	IV/40	IV/50	IV/70	IV/90
Relative Scale of Processor Power (2msec processor)	1	1	1	1	1	2 to 8
Standard Memory (bytes)	24K	24K	24K	24K	24K	96K
Maximum Memory (bytes)	24K	24K	96K	96K	96K	192K
Display/Keyboard (Max)	1**	1**	16	24	32	32
Character Printers (Max)	1	1	16*	24*	32*	32*
Disk						
No. of Drives	—	—	—	1-4	1-4	1-4
Capacity/Pack	—	—	—	67.5Mb	50 or 67.5Mb	50 or 67.5Mb
Diskette Capacity (one drive)	—	354Kb	354Kb	354Kb	354Kb	354Kb
Cartridge Disk						
Capacity per Drive	2.5Mb	2.5Mb	2.5Mb	—	2.5Mb	2.5Mb
Number of Drives	1	1-3	1-3	—	1-4	1-4
Number of Magnetic Tape Drives	—	—	—	—	1-4	1-4
Card Reader (300 or 600 cpm)	—	—	Yes	Yes	Yes	Yes
Software						
Data IV	Version 1	Version 3	Version 1, 2, 3	Version 1, 2, 3	Version 1, 2, 3	Version 1, 2, 3
NTP	—	NTP100	All	All	All	All
Vision	—	—	—	—	Yes	Yes
Foreword	—	Yes	—	—	Yes	Yes

*Line printers can be substituted for character printers; at 1,800 lpm, up to two line printers can be attached.
**A second display/keyboard can be added in place of the optional character printer.
Note: When "all" is shown for NTP, the packages offered are: NTP/130, NTP/150, NTP/200, NTP/230, NTP/250, NTP/120, and NTP/220.

ware packages supplied with the System IV. The users can either tailor the software (parameter setting) or use portions of the software in developing their own package. Users can program in COBOL IV/70, RPG IV/70, or a Four-Phase general-purpose assembly language-IV/70 Code.

User-developed programs can be compiled on a System IV with the following resources: 48K bytes of memory, a disk drive or a cartridge disk, a card reader, and a printer. Otherwise, the programs can be compiled on an IBM System/360 or 370 operating under OS or DOS with a minimum of 65K bytes of memory.

Four-Phase program development support software includes:

- Interrupt Disk Operating System (IDOS): A control system for program entry, library storage, editing, assembly or compilation, loading, and execution. IDOS is completely disk resident and is not required in memory during application program execution.
- COBOL: An industry-compatible high-level language consistent with ANSI standards. Four-Phase COBOL provides video extensions for support for interactive multiterminal applications.
- IV/70 Code Assembler: A two-pass assembler providing external reference, storage allocation, constant-defining and conditional assembly features.
- FCODE/360 Assembler: A CODE-compatible assembler that compiles on an IBM 360/370 system under DOS OR OS to produce System IV/70 object code.
- Video Display Library: A set of keyboard and video subroutines used to implement specific terminal characteristics.
- Relocatable Overlay Loader: A linking loader with overlay capability used to combine DOS object modules and disk library files.
- Utilities: A collection of programs to aid in system development. Included are media conversion routines, a symbolic editor, and input/output drivers for all System IV peripherals.
- Diagnostics: Hardware check-out programs for the processor, memory and peripheral devices. Data set diagnostics incorporate loop-back tests for quick isolation of transmission line faults.

Data IV Versions 1, 2, and 3 and Network Transaction Processing (NTP) are software packages designed to facilitate data entry. Descriptions of Data IV Versions 1, 2, and 3 and NTP Packages follow.

DATA IV

The Data IV package provides the software for the key-to-disk entry function. The package can operate on all Four-Phase clustered systems and is available in three versions.

Data IV Versions 1 and 2. The basic Version 1 supports up to 12 keystations, allows up to six input formats and nine value sets per job, and assigns up to six balance accumulators per data entry batch. Version 2 expands the number of keystations supported to 22; it can support the 1920-character display unit and allows up to 15 formats and 15 value sets per job, and it can assign up to 24

accumulators per batch. Additional logical operands allow conditional formats to be nested in this version; as a result, alternative branches with totally different editing sequences can be specified based on validation tests of previously entered data. Version 2 can also support any mix of workstations using the IBM 029-type of keyboard or the typewriter-type of keyboards. One or the other keyboard types must be selected with Version 1. IBM 2780-compatible communication, however, is supported by both Versions: minimum processor memory size is 24K bytes for a Version 1 package and 72K bytes for Version 2.

Control of the keystations follows the same general pattern as most large key-to-disk systems. Operators can key in an identifier that places the keystation under control of a formatting program stored on the disk. The program can define automatic skipping, duplication, left justification, modulus seven, ten, or 11 check digit fields, balance fields, validity checks (numeric or alphanumeric entries), range checks, and so on for each format. Meanwhile, the processor automatically keeps a tally of operator performance statistics and batch control statistics, and it can automatically re-format records while adding control data needed for each batch. The CRT terminal allows visual verification and keyed verification by the same or different operators as well as various types of checks on individual fields.

Data IV Version 3. Version 3 incorporates the following capabilities that can operate concurrently:

- Data entry — users are able to enter and validate source data on formatted video display screens. Operating under Version 3, Four-Phase systems can extract file information for automatic inclusion with the newly entered data, update local files on-line, produce local reports, and exchange batch work with a host computer
- Information retrieval and update — Data IV Version 3 retrieves and updates information automatically when record numbers of information records are keyed into the system. Records of up to 750 characters may be retrieved instantly and displayed; any file may be accessed simultaneously by up to 16 operators. From 2.5 to 264 million bytes of disk storage is supported for on-line access, for up to 1000 indexed sequential files.
- Communications — Asynchronous or synchronous communications up to 9600 bps using either leased or a dial-up lines is supported.

Version 3 provides many of the same features that the two previous versions of Data IV offered: table checks, multiple range checks, arithmetic checks, batch balancing, cross footing, format chaining, field generation, and conditional logic. However, Version 3 expands on its predecessors' capabilities by increasing the available disk size from 2.5MB, the maximum available with Version 1 and 2, to 2.5MB, 10MB, or 67.5MB (the 67.5MB disk is available only on the System IV/70 and IV/90 models). Version 3 extends its emulation capabilities to include IBM 3780, while Versions 1 and 2 offer only IBM 2780 emulation.

In addition to these capabilities, Version 3 offers distributed processing networks the ability to generate documents such as invoices, purchase orders, and sales reports. With Version 3, data can be preprocessed, reformatted, and printed with headings and text inserted. COBOL and RPG own-coding can be added to the package.

NTP and Version 3. NTP and Data IV Version 3 are two packages designed to perform essentially the same functions. NTP, however, permits interactive inquiry with the host processor. Version 3 is designed to do data entry, local file updating and retrieval, and then transfer the preprocessed data to the host computer in batched mode. Version 3 is a simpler software system; it has pre-defined parameters for the functions it is designed to perform. NTP must be programmed using COBOL. Table 2 lists the features that differentiate NTP from Data IV Version 3.

Table 2. Differences Between NTP and Data IV Version 3

Description	NTP	Version 3
Max No. of Displays	32	16
Transmission Mode	Interactive inquiry (IBM 3270)	Batch (IBM 2780/ 3780)
Programming Methods	COBOL Statements	Pre-defined parameters; COBOL statements optional
File Access Methods	Direct sequential (DISAM); variety of other methods	Indexed sequential using alpha/ numeric keys
Available Disk Sizes (MB)	2.5, 10, 67.5*	2.5, 10, 67.5*

*67.5M byte disk not available on System IV/40, 30, 55

NTP is currently a group of eight software modules designed to support varying degrees of local processing. The original six packages include the following:

- NTP/100 is an enhanced 3270 simulator. It is a plug-compatible alternative to IBM's 3270. NTP/100 is intended for data entry and inquiry activity. It requires a minimum of 24KB of memory
- NTP/130 is an enhanced IBM 2780 and 3780 simulator. It features local batch processing using COBOL and RPG. In addition, it offers disk spooling. It requires a minimum of 24KB of main memory
- NTP/150 is an enhanced 3270 simulator with COBOL. It provides local intelligence to the terminal for control and editing functions. It requires a minimum of 48KB of main memory
- NTP/200 is a COBOL package with screen processing. The package supports a stand-alone system and does not have a communications capability. It offers a generalized local data base processing capability. A minimum of 48KB for program development and a minimum of 24KB are required for operation
- NTP/230 is a COBOL package with IBM 2780 and 3780 access. It permits local interactive capabilities to be added to remote batch entry facilities of NTP/130. It requires a minimum of 48KB of main memory
- NTP/250 is a COBOL package with 3270 access. It offers a local inquiry mode of operation by adding

local data base capabilities to the 3270 access. Inquiries can be made of the local or remote data bases. It requires a minimum of 48KB of main memory

The later additions to the NTP group, NTP/120 and NTP/220, are best described as remote batch and HASP multileaving systems, respectively. The two packages provide compatibility with any IBM System/360 or 370 that utilizes HASP multileaving bisynchronous protocol. Multileaving transmission permits card, printer, punch, and operator messages to be mixed in a given message block.

- NTP/120 is a turnkey package for remote batch terminal functions. It provides IBM 360/20 HASP workstation compatibility and is written in COBOL. Even though it is a turnkey system, NTP/120 can be modified by the user. It supports one display station, card input, and printer output. It requires a minimum of 48KB of main memory
- NTP/220 is a HASP multileaving batch package. It consists of a set of COBOL callable subroutines. It can support multiple display stations, disk drives, character and line printers, and a card reader. It requires a minimum of 48KB of main memory

Data IV Version 1 data entry software with batch communications to the central host, can run on the stand-alone System IV/30. Custom programming is available, through the use of the assembler, for capabilities in addition to data entry. System IV/55 provides on-line data entry and retrieval through NTP 100 software, providing IBM 3270 operating characteristics and display commands. Since NTP 100 software is the only NTP package operable on the IV/55, the prime use of the IV/55 is to simulate an IBM 3270.

Other Packages. VISION, a transaction-oriented processing package, provides concurrent access to local files and a central data base. It accommodates multiple operators, jobs, and functions simultaneously on the same system. A multitasking operating system supports a dialog-oriented formatting language and a macro command language for concurrent report and document generation. VISION communicates interactively with host mainframes using IBM 3270 protocol; or, data may be exchanged in batch mode with a host mainframe using IBM 2780/3780 protocol.

ForeWord is a shared-logic word processing system to be used with a system IV/40, IV/50, IV/70, or IV/90. The system supports up to 16 displays, 16 printers, and four disk drives. In addition, it provides on-line storage capacity ranging from 400-40,000 pages of text.

STARTER is a package used to create screen formats, when developing COBOL programs.

DISPLAY/KEYBOARD

Display stations contain a video display and keyboard. A 120-character ASCII character set including upper and lower case alphabetics, numerics and special symbols are displayed. Character generation is provided by 7 x 9 dot matrix.

Cursor controls allow the cursor to move right, left, up, down, home, and return. In addition, a blinking cursor is provided. Editing capabilities include character or line insert/delete as well as screen and line erase. A scrolling feature rolls the displayed text up or down, line by line. Optional features include variable intensity and an audible alarm.

A 12-line, 40 character-per-line CRT display and a 24-line, 80 character-per-line display are popularly used with the System IV. When the larger, 1920 character display is used along with NTP software, only half the allowable displays (per model) can be operative, due to buffer capacity for servicing the extra screen lines.

OTHER PERIPHERALS

Four-Phase's peripheral offerings consist of disk support in the forms of diskettes, cartridges and packs, magnetic tape and card readers. Other offerings include printers, operators' terminals and a varying number of display lines per screen. Not all peripherals are available with each model and software package chosen. The terminals are marketed to provide varying amounts of processing power and storage to meet different users' needs.

There are four disk models available. The transfer rates for these peripherals are as follows:

Cartridge disk	184Kbps
Diskette	32Kbps
Disk pack (50M bytes)	312Kbps
Disk pack (67.5M bytes)	250Kbps

Five magnetic tape systems can be used with the Four-Phase systems IV/70 and IV/90. Both 7- and 9-track magnetic tape at speeds from 12½ to 37½ ips are available. Reel sizes include 1,200 and 2,400 ft models, and densities range from 556-1600 bpi.

Three character printers and three line printers are available. Character printers operate at speeds of 30 and 165 cps, and the line printers operate at speeds of 145-1110 lpm, 300 lpm, and 700-1800 lpm, respectively. Card readers include two desk-top models with speeds of 300 and 600 cpm.

Operator terminal configurations vary in characters and lines per screen, as well as characters per line, depending upon which NTP series are supported. Table 2 details these screen configurations.

MAINTENANCE

Four-Phase Systems field engineers provide maintenance for System IV intelligent terminals in major metro-

politan areas. The company handles maintenance support through over 70 branch offices nationwide. Round-the-clock customer service is provided by a staff of more than 350 field service engineers. Major replacement parts are available at branch locations and selected depot sites. Four-Phase offers a one-year warranty on purchased systems.

PRICE DATA

Prices for typical configurations for the System IV intelligent terminals follow.

System	Video Display	Memory bytes	Mass Storage	Printer	Monthly Rental $	Purchase Price	Monthly Maint $
IV/30	1 1920-char	24K	2.5Mb Disk		347	25,000	140
	2nd display				35	1,845	7
IV/40	4 1152-char	24K	2.5Mb Disk		611	37,440	166
	16 576-char	72K	2.5Mb Disk		1,283	66,700	321
	*1 1152-char	24K	354Kb Diskette	1-300 lpm	777	47,350	253
	16 480-char	48K	354Kb Diskette		1,073	57,490	292
	8 1152-char	72K	2.5Mb Disk	1-300 lpm	1,334	69,330	349
IV/50	12 Dual Intensity	72K	2.5Mb Disk 354Kb Diskette	1-30 cps	1,497	93,145	411
IV/55	1 1920-char	24K	354Kb Diskette		234	19,500	95
	2nd display				35	1,845	7
IV/70	12 288-char	24K	2.5Mb Disk 9-trk Mag Tape		1,440	68,115	316
	22 288-char	72K	2.5Mb Disk		2,017	95,655	461
	32 480-char	48K	354Kb Diskette		2,091	98,045	486
	16 1152-char	96K	67.5Mb Disk 9-trk Mag Tape	1-300 lpm	2,880	138,315	717
IV/90	12 1920-char	192K	2-67.5Mb Disks	1-600 lpm	3,387	175,865	930

Note:
All models include a Communications Controller (Async or BSC). The IV/90 also supports a processor-based controller using BSC or SDLC protocol.
*Includes a 300 cpm card reader

HARRIS CORP.

Series 800 and 8000 Terminal Systems

OVERVIEW

Harris Corporation's Data Communications Division (formerly Sanders Data Systems) is now actively marketing and supporting the Series 800 and 8000 Terminal Systems originally introduced by Sanders in 1971. The Series 800 and 8000 Terminal Systems are a family of self-contained, intelligent communications terminals designed around a common processor and memory, with full software and peripheral expansion capabilities. Featuring a variety of hardware components and software packages (which can be applied to a wide range of data processing applications), the Series 800 and 8000 offer several models designed to accommodate and emulate IBM, Univac, Burroughs, and Honeywell terminal communications protocol.

The older Series 800 consists of: the Model 804 standalone programmable terminal, the Model 810 programmable clustered terminal system, and the Model 8100 remote batch terminal system. The 8140 and 8141 remote batch systems are no longer marketed. All three Series 800 systems feature the same basic components: microprocessor, expandable program memory, universal modem interface, CRT display, and typewriter-style keyboard. Additional memory, a card-reader, dual cassette drive, ROM (Read-Only-Memory) Loaders, alternate keyboards and printers, and seven additional CRT displays can be added as options to the basic Model 804 terminal. The Series 800 terminal systems can be characterized as programmable replacements for IBM's 2260/2265 and 2770/2780 terminal systems.

The newer Series 8000 terminal system consists of the Model 8170, 8180, 8210, 8220, and 8770 intelligent, multistation display terminal systems that can be configured to support up to 32 CRT displays and/or printers, and emulate IBM's 3270, Univac's Uniscope's 100/200, Burroughs' TD 800, and Honeywell's VIP 775/7700. Like the Series 800, the Series 8000 terminal system feature: a common microprocessor, expandable program memory, universal modem interface, CRT display, and typewriter-style keyboard. While the Series 800 is limited primarily to remote data entry and batch processing applications, the Series 8000 terminal system can perform: remote data entry and retrieval, local file reference, local data reformatting/selection/storage and validation routines. Also, a Queued Transaction handler enables the Series 8000 to enter data into a mass storage device at the local level without host computer intervention.

Harris Corporation's Data Communications Division is a pioneer developer, manufacturer, and international supplier of CRT-based intelligent terminal systems and distributed data processing techniques.

DATA COMMUNICATIONS

The Harris Series 800 and 8000 employ a variety of data communications methods that are largely dependent on the line protocol and operating system of the host computer system interfaced. Generally, both series can communicate asynchronously or synchronously in half- or full-duplex mode, at transmission speeds of 110/300/600/1,200/1,800/2,000/2,400/3,600/4,800/7,200/ and 9,600 bps. Additional transmission speeds can be attained via external clocking.

The Series 800 Model 804 and the Series 8000 Models 8170 and 8180 terminal systems utilize IBM 2780 ASCII and EBCDIC bisynchronous communications protocol and BTAM/QTAM/TCAM (Basic-Queued-Telecom-

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munications) access methods to communicate with IBM System/360 and 370 computer systems operating under OS/DOS operating system software. The Model 810 and 8100 terminals utilize the same access methods, but only with IBM 2780 EBCDIC bisynchronous communications protocol.

The Model 8170 and 8180 terminal systems can emulate the IBM 3270 terminal through its built-in SDLC (Synchronous Data Link Control) in a SNA (Systems Network Architecture) environment. SNA is implemented through a single sharable access method, VTAM (Virtual Telecommunications Access Method), providing a means for reducing redundant communications networks by permitting line and terminal sharing between applications. SDLC provides greater efficiency for a given line speed by allowing the attachment of more terminals on the line. The SNA and SDLC combination gives the Model 8170 and 8180 systems the ability to offload line control and error recovery functions to an IBM 3705 front-end processor.

The Series 800 and 8000 systems also employ a communications adapter for an RS-232-C serial interface for connection to an external modem.

COMPATIBILITY

The Harris Series 800 and 8000 terminal systems are completely hardware and software compatible with IBM System/360 Model 30 or above, IBM System/370 Model 135 or above, and any ASCII-supported computer system.

The Series 800 is also compatible with the following terminal systems.

- IBM 2260/2265
- IBM 2770/2780

The Series 8000 is compatible with the following terminal systems:

- IBM 3270
- Univac Uniscope 100/200
- Burroughs TD800
- Honeywell VIP 775/7700

COMPETITIVE POSITION

Designed as direct replacement units for IBM, Univac, Burroughs, and Honeywell terminal systems, the Series 800 and 8000 are competitive with those companies' products as well as a number of major independent vendors; Four Phase, Incoterm, Raytheon, and Sycor.

Harris, like most manufacturers of stand-alone replacement systems, provides added terminal intelligence at the same or lower cost than a comparable IBM 2260/2265 terminal installation. A typical IBM 2770 terminal system with a 256/512-word controller and 12 Model 2265 CRT displays, leases for $2,265/month or may be purchased for $78,000. The IBM system, however, lacks the processor memory (4K-8K), disk capacity (5M bytes), CRT screen size (1,920 chars) which are inherent features of the Harris Series 800 Model 810 and 8100.

Among the major independent terminal system vendors, the Raytheon PTS-100, Sycor 255, and Incoterm SPD-904 are competitive in price and performance with the Harris Series 800. The Incoterm SPD-904 terminal system leased at $825 per month and $25,000 purchase offers a 4K microprocessor, 1,920-character CRT display, 165 cps printer, 250 cpm card/read punch and IBM 2270/2780 emulation. The SPD-904 also offers Univac 1004 and CDC 200 emulation, a capability found in the more expensive Harris Series 8000.

An outstanding feature not reflected in the lease/purchase price of the Harris Series 800 is its high-level operating system software (IMP) which facilitates the development of application programs . . . a feature which many competitive terminal systems lack.

The Harris Series 8000 terminal system (comprised of five direct replacement units for the IBM 3270, Univac Uniscope 100/200, Burroughs TD 800 Series, and Honeywell VIP 775/7700 systems) is also highly competitive with the Four-Phase System IV-70, Incoterm SPD-20/20, and Sycor 257 terminal systems. The Four-Phase IV-70 is a multi-station, intelligent terminal system designed to emulate the IBM 2780/3780 terminal systems. Featuring a 48K processor, 2.5M byte disk storage, 300-to-1800 lpm line printer, and 1,152/1,920 character CRT, the Model IV-70 serves a variety of data entry, communications, and remote processing functions. Average monthly rental is $1,140. The Incoterm SPD-20/20 is a clustered, intelligent terminal system which employs an 8K processor (expandable to 32K), unique 7 by 10 dot matrix display 960/1,920 characters, and supports up to 64 devices. Sycor's Model 257 is a clustered intelligent terminal system (supporting up to 32 units), featuring an 8K processor with a 480/1,920 character display and I/O peripheral devices.

Unlike their Harris Series 8000 counterparts, the independent vendor terminals are designed primarily to emulate and interface with IBM terminal and host computer systems. Recognizing this, users of Burroughs, Honeywell, and Univac terminal systems will find the Harris Series 8000 terminal units, communications protocol and supporting software ideal for their diverse needs.

USER CASE HISTORIES

Two of the Harris Series 800 users interviewed originally purchased their terminal systems from Sanders Data Systems.

The first user, representing a large life insurance company, uses Model 804 terminals in 141 remote locations to store and transmit detailed agent billing/collection data to an IBM System/370 Model 155 host computer. According to the company, the Series 800 terminal system has substantially reduced administrative costs by saving five man-hours per week/per agent, cutting paper costs and improving financial controls.

A state highway patrol department uses a Model 810 in an extensive on-line network with an IBM System/370 Model 145 for accident identification and statistical analy-

sis. The Model 810 operators key data into a format that is a video replica of specially designed accident forms completed by the police at the accident scene. Numeric codes on the source document relating to physical and environmental conditions facilitate data entry. Operating under the Harris SPAN software package, the Model 810 permits both free-form and formatted data entry functions with high-volume input.

One of the Harris Series 8000 users contacted by Auerbach was a medium-size electronics manufacturer with a Model 8170 configuration used for order entry and inventory control applications with an IBM System/370 Model 145. The system's reliability, high performance, and IBM 3270 emulation capability were cited as outstanding features by this user. The built-in test and line monitoring (diagnostics) feature providing rapid fault isolation and maintenance also received high marks.

SYSTEM DESIGN

Both the Series 800 and 8000 terminal systems have the same functional components: LSI microprocessor, CRT display, and typewriter-style keyboard.

The LSI (large-scale integrated) microprocessor available on the Series 800 system has 4K-bytes of memory expandable to 6K or 8K bytes, an average instruction execution time of 6.4 μsecs, and 16-bit words. The first 256 bytes of memory are dedicated to read-only memory bootstrap loading. A direct register interface to the I/O bus is provided by 16 user registers, enabling programs to be loaded directly from an attached peripheral device (without a processor I/O operation by way of a separate hardware channel). The Series 8000 microprocessor has 12K-bytes of memory, expandable to 16K bytes.

The CRT display is available in a variety of configurations: the standard 1024 by eight-bit refresh memory allows 960 characters per screen, displayed as twelve 80-character lines or fifteen 64-character lines. An optional 2048 by eight-bit refresh memory allows 1,960 characters to be displayed as twenty-four 80-character lines. A 480 character display consisting of twelve 40-character lines is also available on the Series 8000. The viewing area is 12 inches diagonal, and characters are generated using a 5 by 7 dot matrix on the Series 800 screen, and 7 by 9 dot matrix on the Series 8000. The standard Series 800 character set consists of 64 ASCII characters with 26 optional lowercase characters and limited graphics, while the Series 8000 standard character set consists of 96 ASCII characters (128 international character set).

An alphanumeric typewriter style keyboard is standard for both series. Optional keyboard styles include: IBM 2260 Data Entry; typewriter style with numeric pad; Teletype style with numeric pad; and Teletype style with special symbol keys optional. Standard keyboard features include typamatic keys, an audible alarm, a seven-keyboard indicator lights, and a two-position keyclick switch. An optional Photopen light sensor is available as an alternative data entry device.

Peripherals

Harris offers a full array of peripheral devices that can be configured with the Series 800 and 8000 terminal systems.

PRINTERS. Three models are available. The 3110 Character Printer has a rotating print wheel with a single hammer to print at 30 characters-per-second. The 3120 Dot Matrix Printer prints 132-character lines at 165 characters-per-second under partial control of a two-channel tape loop. The 3130 Line Printer is a desk-top model chain printer that prints 170 lines-per-minute using the 64-character ASCII set. All three models print up to 132 columns at 10 pitch horizontal and six pitch vertical and accommodate pin-fed forms up to six-ply. A special modified ASCII character set is available for use in England. The user must specify local or remote (on-line) operation for each printer.

TAPE CASSETTE. The model 3210 Tape Cassette Drive (with Philips-type cartridges) provides phase-encoded, dual track units with 800 bpi recording and 300,000 character capacity per cassette. Beginning of tape, end of tape, and file protect sensors are standard features.

DISK. The model 3430 moving-head disk device with one fixed and one removable cartridge provides 5M bytes of storage and has an average access time of 60 milliseconds. The model 3430 disk is available only with the Series 800 Model 810 and 8100 and the Series 8000 Model 8180 terminal systems.

CARD READER. The Model 3310 Card Reader processes 300 cards-per-minute and can be used to load programs into the microprocessor or tape cassette unit.

CHANNEL ATTACHMENT. Local attachment to an IBM byte multiplexor channel is accommodated by the Harris channel adapter which can support up to four terminal processors.

Series 800 Model specifications appear in Table 1; Series 8000 Model specifications appear in Table 2.

SOFTWARE

The Series 800 can operate under the control of a number of software packages that emulate IBM 2260 (local or remote), 2265, modified 3270, direct 3270, 2780 Models I and II, and 2770 operation. The 804 terminal system can also operate under an INFORM or SPAN cassette data entry package. All are complete system packages that include executive functions, utility routines, such as debuggers and diagnostics, and system peripheral handlers. Four versions of the ROM bootstrap loader are available for program loading by way of a card reader, a cassette drive, the disk (810 only), or the modem interface.

Table 1. Harris Corp. Series 800 Terminal System: Specifications

Description	804	810	8100
Control Processor			
Memory Size (bytes)	4K	4K–8K	8K
Word Size (bits)	16	16	16
Cycle Speed (msec)	6.4	6.4	6.4
Transmission Code	ASCII; EBCDIC	ASCII; EBCDIC	ASCII EBCDIC
Max I/O Devices	3	16	16
Utilities	Assemblers/Loaders; RJE; Diagnostics	Assemblers/Loaders; RJE; Diagnostics	Assemblers/Loaders; RJE; Diagnostics
Peripherals			
Cassette	Dual Drive	Dual Drive	Dual Drive
Magnetic Tape	NA	NA	NA
Printers	30/160 cps; 170 lpm	30/160 cps; 170 lpm	30/160 cps; 170 lpm
Punch Card (cpm)	80 col; 300 cpm read	80 col; 300 cpm read	80 col; 300 cpm read
Disk	NA	5.0MB	5.0MB
Display Unit			
Screen Size (char)	960; 1,920	960; 1,920	960; 1,920
Chars per Line	64; 80	64; 80	64; 80
Lines per Display	12; 15; 24	12; 15; 24	12; 15; 24
Char Set	122 (upper/lower)	122 (upper/lower)	122 (upper/lower)
Char Generation	5x7 dot matrix	5x7 dot matrix	5x7 dot matrix
Data Transmission			
Line Facility	Leased; Switched	Leased; Switched	Leased; Switched
Line Speed (bps)	110 to 9,600 async; 2,000 to 9,600 sync; external clock	110 to 9,600 async; 2,000 to 9,600 sync; external clock	110 to 9,600 async; 2,000 to 9,600 sync; external clock
Line Mode	HDX; FDX	HDX; FDX	HDX; FDX
Line Code	ASCII; EBCDIC	ASCII; EBCDIC	ASCII; EBCDIC
Synchronization	Asynchronous; Synchronous	Asynchronous; Synchronous	Asynchronous; Synchronous
Interface	RS232; TTL	RS232; TTL	RS232; TTL
Compatibility			
Computer System	IBM SYS/360; SYS/370 any ASCII Supported	IBM SYS/360; SYS/370 any ASCII Supported	IBM SYS/360; SYS/370 any ASCII Supported
Terminals Emulated	IBM 2260/2265; 2770/2780	IBM 2260/2265; 2770/2780	IBM 2260/2265; 2770/2780
Bell Data Set	103; 201; 202	103; 201; 202	103; 201; 202
First Delivery	1971	1972	1974

Software Packages

In addition to the simulators described below, Harris supplies 360/370 cross assemblers that allow user programs written in a language syntax similar to OS or DOS 360 BAL to be translated into PDS, the machine language used for the 800 series. The cross assemblers are designed to operate in IBM System 360/370 environments with limited storage; typical 2,000-card or 1,500-instruction assembly takes 35 seconds on a System 370/155 equipped with a 3330 disk storage unit.

IMP. The Harris Information Management Package (IMP) is a high-level software system comprised of a Disk Management System and Interpreter Program Generator, which control the Model 810 operating functions and application program development. The IMP Interpreter Program Generator is core resident and is used to create, modify, and save the IMP programs.

BOSS-804. BOSS is an emulator that makes the 804 processor look like an IBM 2265 stand-alone display. BOSS-804 requires 4K bytes of buffer storage for the printer, if it is included. An extended version of 804 BOSS supplies additional editing features similar to IBM's 3270. The features allow insertion and deletion of characters and lines, protected and variable data fields, and cursor movement to any screen position in the protect mode.

BOSS-810. The BOSS-810 emulator supports a cluster of up to eight CRTs and one printer, looks like an IBM 2260 multiterminal system and has the same subprogram types as BOSS-804. A version with channel attachment for local operation is also available.

RJE. A limited emulator for IBM 2780 Model I, RJE provides a high-speed, remote batch capability. It is available in two versions. Version 0 is a card I/O, half-duplex system without multiple records, handling only ASCII code (no EBCDIC or transparency). Version 1 has all the features of Version 0 plus cassette I/O for punch or printer simulation.

RJE can run on either an 804 or 810 with suitable adjustments. In addition to the basic program package, the 810 system has RJE packages for 2780 EBCDIC and 2770 EBCDIC. These two packages have the same basic functional characteristics as the basic ASCII package.

SPAN. The SPAN software package allows the 804 or 810 to emulate IBM 2260/2265 communications disciplines while providing added display and editing capabilities. It features both free-form and formatted data entry functions. It was designed for applications with high-volume input and varied formats, such as sales and service order entry, freight invoice handling, insurance policy writing, and inventory control.

IN-FORM. The principal application package available with the 804 system is an off-line cassette data entry program. It is a 23-line version handling 1,840-byte records. The operator also can communicate in an inquiry/response mode with a host computer.

Table 2. Harris Corp. Series 8000 Terminal System: Specifications

Description	8170/8180	8210	8220	8770
Control Processor				
Memory Size (bytes)	12K-16K	8K-16K	8K-16K	8K-16K
Word Size (bits)	16	16	16	16
Cycle Speed (msec)	6.4	6.4	6.4	6.4
Transmission Code	EBCDIC	ASCII	ASCII	ASCII
Max I/O Devices	32	32	32	32
Utilities	Assemblers/Loaders; RJE; Diagnostics	Assemblers/Loaders; RJE; Diagnostics	Assemblers/Loaders; RJE; Diagnostics	Assemblers/Loaders; RJE; Diagnostics
Peripherals				
Cassette	Dual Disk	NA	NA	NA
Magnetic Tape	NA	NA	NA	NA
Printers	30/88/165 cps; 200 lpm	30/88/165 cps; 200 lpm	30/88/165 cps; 200 lpm	30/88/165 cps; 200 lpm
Punch Card (cpm)	NA	NA	NA	NA
Disk	5.0MB	NA	NA	NA
Display Unit				
Screen Size (char)	480; 960; 1,920	480; 960; 1,920	480; 960; 1,920	480; 960; 1,920
Char per line	40; 80	40; 80	40; 80	40; 80
Lines per Display	12; 24	12; 24	12; 24	12; 24
Char Set	96 (lower case opt)	96 (lower case opt)	96 (lower case opt)	96 (lower case opt)
Char Generation	7.x dot matrix	7x9 dot matrix	7x9 dot matrix	7x9 dot matrix
Data Transmission				
Line Facility	Private voicegrade	Private voicegrade	Private voicegrade	Private voicegrade
Line Speed (bps)	600-4,800	300-9,600	75-9,600	300-4,800
Line Mode	HDX	HDX; FDX	HDX; FDX	HDX
Line Code	EBCDIC	ASCII	ASCII	ASCII
Synchronization	Bisync; SDLC	Async; Sync	Async; Sync	Sync
Interface	RS232C; CCITT	RS232C	RS232C	RS232C
Compatibility				
Computer System	IBM Sys/360; Sys/370	Univac 1100-9000	B500-7700	Honeywell 200/400/ 2000
Terminals Emulated	IBM 3270	Univac 100/200, IBM 3270	Burroughs TD800, IBM 3270	Honeywell VIP 775/7700
Bell Data Set	201A/B; 208A	201A/B; 208A	201A/B; 208A	201A/B; 208A
First Delivery	1975	1976	1976	1976

Another part of the IN-FORM package is a descriptor function that allows the creation of formats tailored to users' specific requirements by keying the format parameters onto the CRT. IN-FORM requires 8K of processor memory.

The Series 8000 Model 8170 and 8180 terminal systems use the Harris ON-LINE 2 software package to provide complete address sequence compatibility, command code structure, and communications protocol for IBM 3270 simulation. The Model 8170 executes the full repertoire of IBM 3270 commands via the control program stored in the Series 8000 processor. ON-LINE 2 not only performs the same functions as the IBM 3270, but provides additional data entry edit and validation functions.

The Model 8180 terminal system also features several additional ON-LINE 2 subroutines that can be implemented without any changes to the host computer's application programs. The subroutines include: Local File Reference, Formatted Local Print, Local Format Storage, Local Validation and Arithmetics, Queued Transaction Handling, and Automated Keystrokes. Each of the subroutines functions extend the performance of the Model 8180 beyond that of a comparable IBM 3270 display terminal system.

MAINTENANCE

The Harris Data Communications Division maintains its own field engineering organization with personnel located in more than 60 metropolitan regions of the U.S. as well as seven regions in Canada. With the recent acquisition of Sanders Data Systems, Harris has added 120 service personnel to its field engineering staff.

Harris' standard flat-rate maintenance contract, included with all leased equipment (unless on-site coverage is negotiated) provides for on-call service five days per week, eight hours per day. The customer may choose any consecutive eight-hour interval between 7:00 a.m. and 6:00 p.m. as the prime maintenance period. Customers with purchased equipment can obtain the standard flat-rate contract, or pay on a time-and-materials basis as required.

All Harris purchased equipment is covered by a 30-day warranty during which all maintenance is performed free. A provision covering leased equipment provides for customer acceptance testing prior to the commencement of monthly lease charges.

PRICE DATA

Harris Corp. did not provide price data because of its corporate policy.

HONEYWELL INFORMATION SYSTEMS
DST 6/500 Distributed Systems Terminal

WHAT IS IT?

What is the DST 6/500? Somewhat belatedly, Honeywell, like Datapoint, Four Phase and Sycor, has expanded the marketing definition of intelligent terminals well into the small business systems territory. When the preprocessing of data includes user written subroutines going against local files, and permits bona fide applications oriented data processing, the processor, technically speaking, becomes a small business computer with communications capabilities. This is reflected in the software offered by Honeywell on the DST 6/500; there is not only the disciplined data entry function which has been the traditional realm of intelligent terminals, but also the data processing functions of a computer, supported by a programming language, a compiler, an operating system, data management, utilities, etc. in which the user is free to identify problems, then to go ahead and design and program a system that will solve those problems.

MULTIFUNCTION TERMINAL SYSTEM

The DST 6/500 is a multifunction terminal system. It can support up to four CRT operator display stations with diskettes or cartridge disc storage. The Honeywell Level 6 minicomputer, both hardware and software, also announced this January, is at the heart of the system, and provides for local processing, forms mode data entry, single pass forms creation, table lookup, data validation and editing, user programmable data entry extensions via COBOL or Assembler Language, and file transmission to and from the Honeywell Series 60 (Level 66) or Series 6000 host computer. See Table 1 for Specifications.

Communications Capabilities

The DST 6/500 is compatible with Honeywell's Series 60 (Level 66) or Series 6000 computers, and its Datanet 6670 Front-End Network Processor (also announced as part of Honeywell's Distributed Systems Environment). It operates in synchronous mode, over communications lines, at speeds up to 4800 bps, using Honeywell's own VIP protocol. Line termination equipment should be selected to be compatible with Bell 208 (synchronous modems, with a speed of 4800 bits per second.

TOTAL SYSTEMS APPROACH

Honeywell, following in the footsteps of IBM and Sperry Univac, wants to offer large systems builders, OEM's and end users a total systems approach towards networking and distributed processing. The systems approach includes the total hardware and software packages necessary for systems implementation. Significantly, none of these manufacturers is, or plans to be, compatible at the bits and bytes level with one another. The communications software protocol used by IBM to implement their systems Network architecture is SDLC, Sperry Univac uses their own UDLC for their Distributed Communications Architecture, and Honeywell has joined the bandwagon with the Distributed Systems Environment. Although it is not implemented now, Honeywell plans to use HDLC, the bit-oriented Higher Data Link Control protocol, an approved international standard. HDLC is the second, or link control portion of the recently approved CCITT X.25 international standard for interfacing to public data networks. There are plans to make HDLC compatible with SDLC (the de facto standard) but that is a future development. Although Sperry Univac's UDLC is almost compatible with HDLC, it is not at this time. In communications software, any incompatibility at all means the software is incompatible, period. The implications for the user who wishes to mix and match software and equipment are quite clear — unless you have the time and the resources to engage in extensive software modifications (today, easily the most expensive portion of any system's implementation effort), it is easier to stay with the hardware/software package offered by a single manufacturer.

Aside from the total commitment to a single manufacturer, a trend we see developing rapidly, users will want to consider how the distributed concept is implemented, and what the impact will be for ongoing operation control.

The Honeywell Distributed Systems Environment allows for maximum local independence, because the DST 6/500 can be used for application program development and data processing. Programs are compiled locally, not down-loaded from a central computer. Contrast this with IBM's SNA which requires local program loading from the host computer only. While the extreme independence of the local site may be desirable for the local site, it is going to be impossible for companies that go this route to maintain control over the versions of the

HEADQUARTERS

Honeywell Information Systems
200 Smith St
Waltham MA 02154
(617) 890-8400

Table 1. Honeywell DST 6/500: Specifications

CENTRAL PROCESSORS	
Honeywell Series 60 Level 6 Minicomputer	Model 6/34 with 16 to 32K 16 bit words of memory Model 6/36 with 16 to 64K 16 bit words of memory
OPERATOR DISPLAY STATIONS	
Screen size	12, 80-character lines
Screen area	54 square inches (137.16 sq. cm)
Character set	64-character ASCII code set
Character size	0.80 in. x 0.160 in. (2.03 cm x .40 cm)
DISKETTE SUBSYSTEMS	
Data capacity	256K bytes per diskette (four diskettes maximum)
Transfer rate	Up to 31,248 bytes per second
CARTRIDGE DISK SUBSYSTEM	
Type	Low/high density removable disk only; low/high density fixed and removable disk
Data capacity	Up to 11.2M bytes
Transfer rate	Up to 312K bytes per second
LINE PRINTERS	
Speed	300 or 600 lines per minute
Columns per line	136
Printable characters	64-character ASCII code set
SERIAL PRINTER	
Speed	60 lines per minute
Columns per line	132
Printable characters	64-character ASCII code set
HOST COMMUNICATIONS	
Mode	Synchronous
Speed	Up to 4,800 bits per second

programs installed at the remote locations. Down-loading imposes a discipline. Local program compilation invites modification, which can result in a complete loss of control for the corporate headquarters as it receives "standard" reporting information from its remote sites. Aside from the control problems, the extensive local data preprocessing capabilities of the DST 6/500 will reduce line transmission time and cost, if the data is destined for the host computer.

PUTTING IT TOGETHER

The basic DST 6/500 consists of a Honeywell level 6/34 minicomputer with 16K words of MOS memory, an operator display station, and a single diskette with 256K bytes of storage and a multiline communications processor. The maximum configuration includes up to 64K bytes of main memory available in 8K increments, up to four display stations, two line and/or serial printers and four diskettes with a total of one megabyte of auxiliary storage or optional disk cartridge of five or ten megabytes. Basic and optional configurations are illustrated in Figure 1.

WHAT CAN IT DO?

To its credit, Honeywell has attacked head-on the two-headed nemesis of data processing, which are the problems of assuring the quality and completeness of data entered for processing by an application system. Their data-entry and preprocessing software is well conceived and should save the user a great deal of development time and effort. Essentially, it consists of a keyword-oriented forms description language, which results in a table of field specifications for that form. At data entry time, the table is "executed" by the DST 6/500 software. The user can tack on his own logic in either COBOL or Assembler, which will execute after the specified field is entered. This data preprocessing flexibility will result in more reliable application programs whether they run locally, or in a host computer.

The DST 6/500 supports data entry and data processing development and production functions. The BES2 Level 6 Basic Executive System (the same as is used on Honeywell's level 6 minicomputer) can support any combination of the following tasks running concurrently, so long as there is a display station dedicated to each concurrent task while it is running:

- forms development
- table development
- user written application programs
- forms mode data entry
- file transmission to/from the host system

Forms development functions include:

- Create form
- Modify form
- Delete form
- Print form
- View or print names of form on file
- Transfer form
- View form

Describe Your Forms

Forms creation, maintenance and update is accomplished using an interactive, keyword macro generation language for the creation of tables which define the editing to be performed as each field on the form is entered. Forms creation is accomplished in a single pass. That is, the editing requirements, variable and constant field definitions can be specified from beginning to end at one sitting. Forms development can occur from multiple display stations concurrently, thanks to the reentrant software. Also, a form can be linked to itself or another form, enhancing the data entry process for some applications. The operator creating the form assigns a four character identifier, which is used to call up the form at data entry time. Some of the editing capabilities include: alphanumeric only, range checks, check digit verification table, extraction table, left or right justification, and field mandatory. User written data entry programs may also be specified. These will be executed dynamically when the field is entered. This technique can be used for price extensions, batch totals, and additional validation and editing requirements.

Develop Edit Tables

Users can specify verification or extraction operations in their data entry tables. While a form is being created,

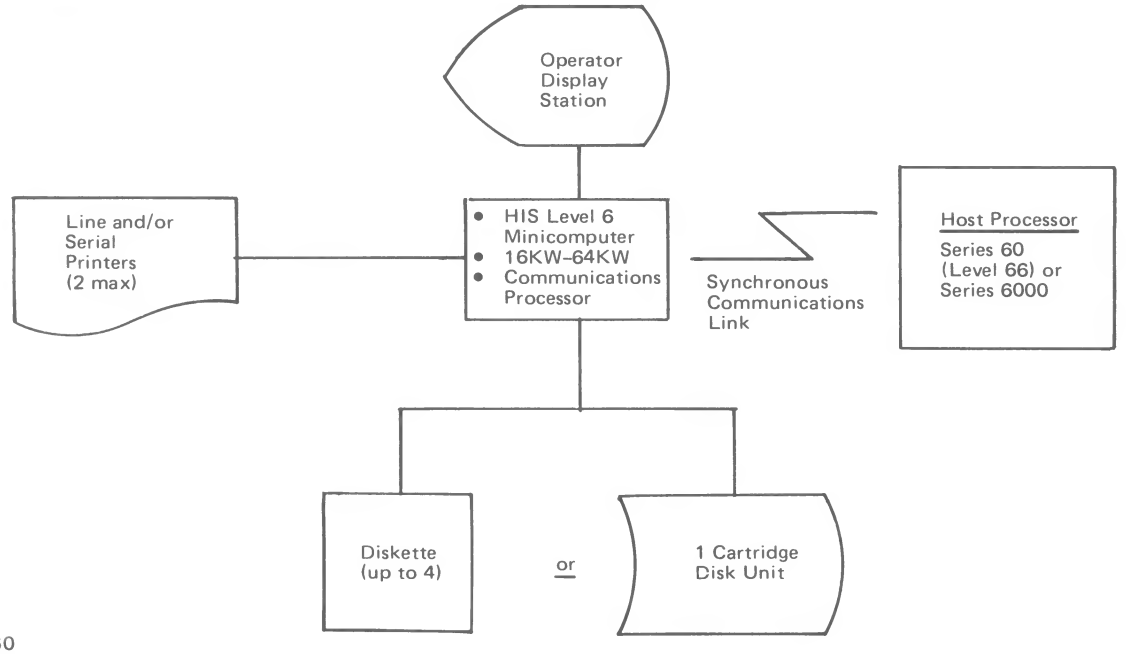


Figure 1. DST 6/500 System Configuration

the user specifies that a particular variable field is to be associated with a verification or extraction operation. Whenever the field in the form is entered, the specified operation will occur. Table functions include table creation, modification, deletion, printing, and viewing operations.

Write Your Own Programs

Honeywell supplies program development software with the DST 6/500. Users can write programs in BES2 COBOL or Assembly language. On multiple station systems, application programs can run concurrently with other functions such as data entry, forms development, or file transmission. Such programs can be used to format and print data received on diskette from a host system, and for any other data processing purpose.

Enter The Data

At data entry time, the cursor advances from one variable field to the other, with the validation and editing routines being performed as specified when the form was developed. If an error is detected, an audible error indication occurs. The operator then makes the appropriate correction and continues to enter the data. Verification and extraction tables are accessed automatically, without operator intervention. When the operator reaches the fields where user written subroutines have been specified, those routines execute automatically.

The data is stored on diskette or cartridge disk where it is available for processing, viewing, modifying, deleting, or transmitting to a host computer. To modify data, the operator specifies partial, single or multiple data fields of the record being searched for. After a match is found, the operator can view the data and modify it as necessary.

PRICE DATA

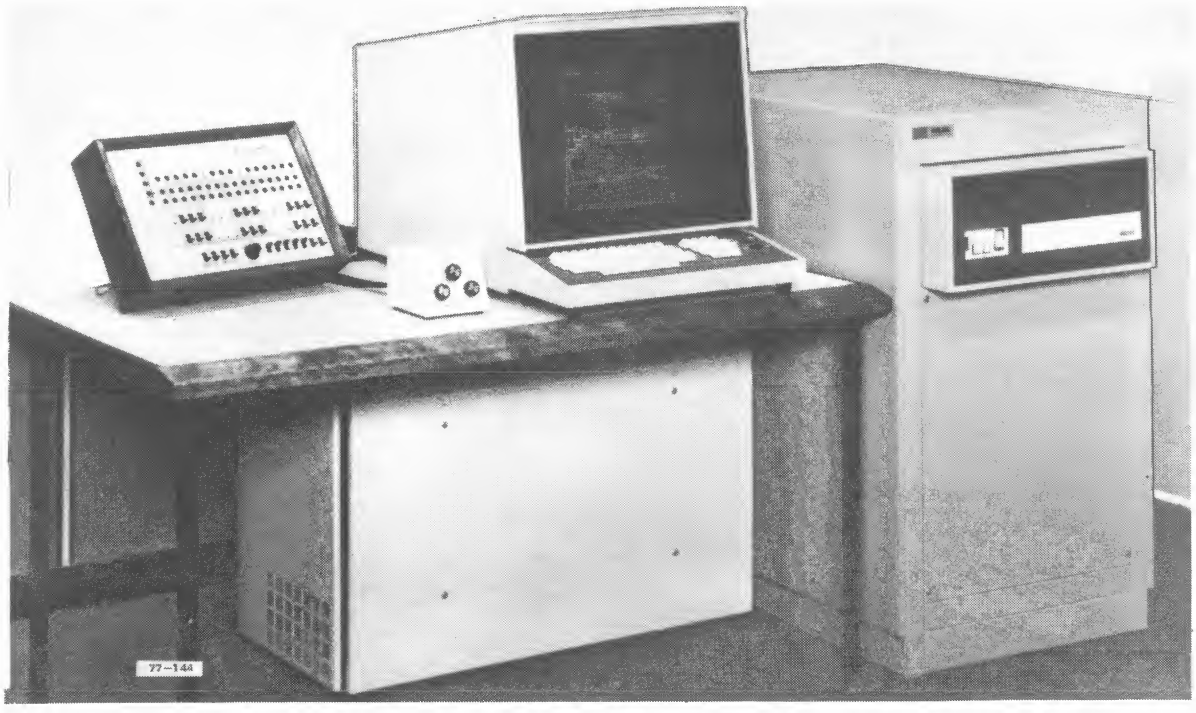
DST 6/500 prices are quoted by Honeywell by small and large configurations, not individual components.

Description	Purchase (maint. not included) $	Monthly* Maint. $	Rental** (maint. included) $
Small Configuration **Level 6/34 with 16K** **Operator Display station** **Diskette with 256 bytes**	$12,000	$147	$366
Large Configuration Level 6/36 with up to 64K Max 4 display stations Max 2 line or serial printers Max 4 diskettes Opt disk cartridge	$30,000	$280	$804

*Maintenance includes Preventive maintenance and systems software support.
**Based on 7 year contract. Shorter contracts at higher prices available.

IMLAC CORP.

PDS Graphic Display Computer



OVERVIEW

Imlac Corporation (founded in 1968) is a manufacturer of interactive intelligent graphic display systems. It has marketed the PDS-1 Graphic Display Computer since 1970 and the PDS-4 system since 1974. The PDS systems are programmable stand-alone or terminal graphics processors. Internally, the systems consist of two independent processors which use system memory in common:

- The main processor (a minicomputer manufactured by Imlac), which performs file I/O, field calculation, and other support functions.
- The display processor, which may be programmed in its own Assembly language to generate the screen displays.

The basic PDS-1, which sells for $8,300, consists of a 15-inch display screen, an operator keyboard, 4K words of memory, the display and main processors, and an interface for telecommunications. A basic PDS-4, which sells for $17,300, consists of similar components, with a 17-inch screen, faster main memory, and a more powerful display processor. A full complement of software is supplied with all systems, including a FORTRAN compiler (disk systems only), Assembler, linking programs, and debugging aids. Also available is a floppy disk system comprising a controller, interface and up to four IBM 3740 compatible disk drives.

For systems sold with cartridge disks, Imlac provides a full disk operating system with file access facilities and support of the programming languages. For systems which use the telecommunication interface, a set of interactive operating software is available, including graphic terminal control programs on the PDS systems and a set of FORTRAN callable support subroutines for the host computer.

To date, some 600 PDS systems have been delivered. Table 1 presents the specifications of the systems.

HEADQUARTERS

IMLAC Corporation
150 A Street
Needham MA 02194
(617) 449–4600

Table 1. PDS System Specifications

CENTRAL PROCESSOR	
Type	16-bit minicomputer
Instructions	43 (PDS-1), 68 (PDS-4)
Main memory size (words)	4K to 32K (PDS-1; 4K to 64K (PDS-4)
Memory cycle time	1 microsecond (PDS-4), 1.8 microsecond (PDS-1)
Memory protection	Optional
Floating point	Optional
Real-time clock	Optional
Interrupt	1 standard, 2 optional
Direct Memory Access (DMA) channel	Optional
Power failure protection	Standard
DISPLAY	
Attachment limits	1 standard, up to 4 independent display processors and screens
Display points	1,024 by 1,024 (PDS-1) 2,048 by 2,048 (PDS-4)
Beam intensities	1 standard, 16 optional (PDS-1) 16 standard (PDS-4)
Hardware blink	optional (PDS-1), standard (PDS-4)
Virtual paging	4 pages (opt: PDS-1), 4 pages (standard: PDS-4)
Character generation	96 characters, upper/lower case
KEYBOARD	
Type	Typewriter with numeric pad
Function keys	16 standard, 36 optional
Light pen	Optional
Joystick	Optional
Trackball	Optional
CARTRIDGE DISC	
Attachment limits	0 to 4
Capacity per unit	10 megabytes
Random access time	35 millisec, average
Transfer rate	180K bytes/sec
Transfer mechanism	DMA
OTHER OPTIONAL PERIPHERALS	
Printer	30 cps or 70 lpm, 132 columns
Plotter/printer	26 sec/plot, 500 lpm
Floppy disk	Up to 4 units (only for PDS-4). IBM compatible
Magnetic tape	Up to 4 tape transports; 9-track, 800 bpi, 12.5 or 37.5 ips
Cassette	120 cps
Paper tape reader	300 cps
Paper tape punch	75 cps
Graphic hardcopy device	8 by 8 inches
Data tablet	14 by 14 to 72 by 72 inches

COMPATIBILITY

All peripherals of PDS Systems are compatible with all PDS mainframes, allowing upgrade from a PDS-1 to a PDS-4. PDS-1 software is also upward compatible with that of the PDS-4. However, the PDS-4 supports additional display generation commands and its software is not, in general, compatible with PDS-1 software.

For PDS systems which use telecommunications, Imlac provides software to communicate with most timesharing systems. Under local program control, the user may specify transmission speed, character parity, and character echoing. Emulators are also available for Tektronix 4010 and 4014 Graphic Terminals.

As part of its standard peripheral options, Imlac has developed a number of direct connection interfaces to most popular minicomputers and some mainframe computers.

PERFORMANCE AND COMPETITIVE POSITION

Imlac was one of the first companies to produce and market stand-alone intelligent graphic systems. The only product line of the company is and always has been graphic-based systems.

The principal difference between the PDS-1 and PDS-4 systems is one of throughput, or graphing rate, and graph sophistication. The PDS-4 uses main memory with a cycle time under 1 microsecond, where the PDS-1 uses 1.8-microsecond memory. A larger display screen is provided as a standard element of the PDS-4 than for the PDS-1, and the display processor of the larger system allows for twice the number of addressable points in both the X and Y directions. The PDS-1 has one display intensity value, and the PDS-4 has sixteen (optional on the PDS-1), which may be associated with any figure on the screen under program control. Hardware blink and virtual paging are optional on the PDS-1 and standard on the PDS-4.

A number of display options are available for the PDS-4 only: a special instruction set provides for display processor scaling, rotation, translation and windowing; an automatic increment feature allows rapid display of very compact data lists. Both units offer an arc generation hardware option and may support multiple independent display monitors.

Over the years, a number of competitors have entered the programmable graphic system market, but Imlac has maintained its position of offering programmable graphics systems at a low cost. To date the minicomputer based competitor with the closest price to the Imlac equipment is the Tektronix 4081 Interactive Graphic Computing System, priced at $27,-000. Recently, microprocessor-based programmable graphic systems have also been announced, principally the Tektronix 4051 BASIC Graphic Computer System (priced under $8,-000), but these devices do not have the display power or peripheral capability of the Imlac systems.

Generally, higher priced programmable graphic systems offer faster processors, faster display rates, larger display areas, or specialized functions such as windowing, reflections, circle and ellipse generators, or three dimensional software. To a certain extent, the relatively low price of the Imlac equipment may be attributed to the use of its own minicomputer.

USER REACTION

Users were interviewed from the engineering, electronics, and medical fields. They were unanimous in stating that the PDS systems had met their objectives, and had proven to be a cost-effective solution to the wide range of applications. Typical user configurations were basically of two sorts:

- A small PDS system configured (often by direct connec-

tion to a general-purpose minicomputer) as a smart graphic terminal.
- A stand-alone disk-based configuration, usually with some telecommunication connection to a remote host computer.

Most users programmed PDS systems in Assembly language or by using host facilities provided by Imlac. FORTRAN is usually preferred by users with disk systems; one user has developed a cross assembler for his host minicomputer. Another user found that the program editing software provided by Imlac was very good, and he uses it as a word-processing system for manual documentation.

Equipment reliability was rated good to excellent by the users. A large number of them performed their own hardware maintenance; the rest used standard Imlac service contracts.

Engineering. One user, an engineering consultant, has a PDS-4 system with a disk and line printer. He uses the system to develop a series of power plant control displays for the electric utility market. The Imlac system was chosen over faster screen displays because of the amount of alphanumeric data which could be displayed on the screen, and it was selected over other graphic systems, such as Vector General, IDI, and Evans and Sutherland, on the basis of cost effectiveness.

The power plant displays make heavy use of both alphanumeric and schematic diagram data as control information for the plant operator. The development work done on the first PDS system was sufficiently successful; additional units were built to the firm's own specifications. Recommendations have been made to place the PDS in a number of power plant control rooms around the world.

Research. A large western university has a number of PDS systems installed in various departments; the bulk of the work is done in the field of medicine. The systems, both PDS-1 and PDS-4, are connected to a large central IBM computer, and typically use emulation software for IBM graphic devices such as the 2250. Here, the Imlac equipment was chosen for its cost effectiveness.

A gamut of both experimental and operational application is running on PDS systems: graphical data reduction of EEG recordings for brain function analysis, pulmonary physiology studies for emphysema research, a very large package of statistical programs used in such departments as mental retardation studies, radiation treatment planning, and an "excellent version of Star Trek." These units are mainly small configurations with few peripherals. The host computer is relied upon for application processing with only graph manipulation occurring at the PDS system.

Simulation Applications. A number of other users were employing PDS systems as graphic control terminals in simulation applications. Two users had flight training systems operational where the PDS system was directly connected to a general-purpose minicomputer. In both systems, the PDS was used as the instructor's display and was used to continuously update training history and simulated radar information.

Another PDS-4 is directly connected to a Data General NOVA minicomputer. It is used by the U.S. Navy to verify operational communications links and protocols. The screen is used in a fashion similar to the standard tactical display screens for exercising, emulating, and verifying communication traffic.

CONFIGURATION GUIDE

The standard PDS system consists of a display screen with display processor that shares memory with the minicomputer, a main processor (16-bit minicomputer), a keyboard, and an RS-232 interface.

The basic PDS-1G includes the graphic display processor, a 15-inch display screen (17- or 21-inch screens are optional), a minicomputer with 4,096 words of memory, an alphanumeric keyboard with programmable function keys, ROM bootstrap for program loading and an RS-232 interface for modems or asynchronous devices (75–600,000 baud). The PDS-1G-8 includes all the above plus an additional 4,096 words of memory.

The basic PDS-4 includes a graphic display processor, a 17-inch display screen (15- or 21-inch screens are optional), a minicomputer with 4,096 words of memory, an alphanumeric keyboard with programmable function keys, a ROM bootstrap for program loading, and an RS-232 interface for modems of asynchronous devices (75–600,000 baud). The PDS-4-8 includes all the above plus an additional 4,096 words of memory.

The basic systems may have the following added to them: memory up to a total of 32K words, three independent display monitors and keyboards, a number of specialized display options, and a variety of peripheral devices (a cartridge disc, a floppy disk unit (PDS-4), paper tape equipment, magnetic or cassette tape drive, a hard copy unit, printers or printer/-plotters and a graphical digitizing tablet).

Mainframe

The central, or main, processor is a 16-bit minicomputer with a .99-microsecond (PDS-4) or 1.8-microsecond (PDS-1) cycle time. It includes 4,096 words as standard, and a maximum of 32K words (PDS-1G) or 64K words (PDS-4). The processor has one interrupt level; another interrupt level is added if a direct memory access (DMA) option is used.

The display processor operates on a cycle-stealing basis using the system main memory; its speed is governed by main memory speed on each model. Operationally, the main processor loads or constructs a display program for the display processor and instructs it to execute the display program. The display processor draws the graphic display, based on the contents of its current display program. The display generation occurs simultaneously with other operations by the main processor.

Optional features may be selected for memory protection, floating point arithmetic, a real-time clock, a DMA channel (with additional interrupt), display arc generation hardware,

scaling, rotation and windowing hardware (PDS-4 only), parallel or serial I/O channels, a programmer console, and special direct interfaces to a number of other computers.

PERIPHERALS

A variety of peripherals are available for the PDS graphic systems; Table 1 lists auxiliary storage limitations.

Cartridge Disk. The disk file system consists of a single disk drive of two platters, one fixed and one removable, with a total subsystem storage capacity of 10 megabytes. Data transfer is at the rate of 180K bytes per second, with a random access time of 35 milliseconds. Disk transfers occur through the system DMA channel. Systems with disks are provided with the Imlac Disk Operating System.

Magnetic Tape. Units are available to support both 1200- and 2400-foot reels, using 9-track tape recording at 800 bpi. Transport speed is 12.5 or 37.5 ips.

Floppy Disk. Dual floppy disk drives may be attached to the PDS-4. The units operate across the DMA channel. This floppy disk system comprises a controller, interface, and up to four IBM 3740-compatible disk drives. Minimum system requirements for use with the system is 16K bytes of core memory.

Cassette. A read/write cassette drive is available for recording at 120 cps.

Paper Tape Equipment. A photoelectric paper tape reader, operating at 300 cps, and a paper tape punch, operating at 75 cps, are available.

Graphic Hardcopy Device. This optional unit creates a permanent exact copy of the display screen on an 8-inch-square sheet. It may be connected directly to the system display or driven as an independent display.

Digitizers. A data tablet with a 14- or 72-inch square surface is available, as well as a graphic mouse for the digitizing of input. Both a joystick and lightpen are available.

Printers. Printers (132 column) operating at 30 cps or 70 lpm are available. A 500 lpm printer plotter is also offered.

DATA COMMUNICATIONS

Communications on the PDS systems are performed using a standard serial asynchronous I/O port. Standard asynchronous protocols are supported — as well as transmission speeds from 110 to 4800 baud. Transmission speed, parity selection, echoing and termination character selection may all be specified by the operator. On the PDS-4, a high-speed serial communication feature is available which buffers transmission of a word, rather than a byte, between the main processor and the modem.

A number of software utilities are provided for operation in a communication environment. LINDI (line to disk) is a timesharing line/disk program which operates under the Disk Operating System and allows interaction between the PDS system and any timesharing host computer. LINDI provides for transmission from or to either the display screen or a specified disk file with selection of destination under the control of the operator. Thus the user may perform a normal CRT terminal screen interaction with a timesharing system and, at appropriate times, receive a stream of data onto a disk file for further analysis or graphic display.

The Terminal Interface System (TIS) is a software program which was developed in conjunction with the Graphic Compatibility System (GCS) of the U.S. Military Academy. It provides support on the PDS system for functions generated by a set of FORTRAN callable subroutines of the GCS system. Under TIS, the PDS system can emulate a timesharing interactive terminal, can execute GCS graphic output commands, and can construct graphic displays either when connected to GCS or in stand-alone mode.

SOFTWARE

Imlac offers a complete series of standard utility and support software packages. Software modules are designed to support all system configurations. In addition, Imlac provides a set of interactive software, on both the PDS and host systems.

For local processing, Imlac offers a resident, disk-based FORTRAN compiler, which may operate in as little as 16K words of memory. A number of important extensions have been provided within the language to allow for the construction of graphic displays; display variable declarations; point, line, and character display orders, and other display management functions are provided to the user through verb extensions. The compiler runs by generating assembler language output, which may then be run through the native assembler to generate an object program.

In addition to supporting minicomputer codes, the native assembler includes a special set of codes to specify display processor programs. Output may be either in absolute or relocatable format, and a relocatable loader is provided. Cross assemblers are also available for host machines. Other standard software components include an editor, debugging programs, and peripheral utilities.

For PDS systems equipped with disks, a Disk Operating System is standard. The disk operating system consists of a monitor, which is used to invoke system or user programs, and a set of disk access functions to operate with the local database. The system also supports a 'run control file' in which a series of operator commands may be automatically invoked in sequence. A full set of utility programs are available, including file and volume copying, disk to printer, file packing and unpacking, and storage allocation maintenance.

MAINTENANCE

Imlac offers standard maintenance contracts directly nationwide, on an 8-hour, 5-day-week basis. System maintenance is priced at the rate of 0.9% per month of system purchase price.

PRICE DATA

Imlac Corp. supplies only purchase prices; monthly maintenance prices can be calculated by multiplying purchase price by .009 and monthly rental prices can be calculated by multiplying purchase price by .044 (one year lease rate).

PRICE DATA

Model No.	Description	Purchase Price (Maint. not incl) $
	GRAPHIC DISPLAY PROCESSOR	
PDS-1G	15-in. high resolution, high contrast CRT general-purchase mini-computer with 4,096, 16-bit words of 1.8-μsec memory. A/N keyboard with programmable function keys, read-only memory bootstrap program, RS-232 interface for both modem and TTY Devices (speeds from 75–600,000 baud)	8,500
PDS-1G-8	Includes all of the above features plus an additional 4,096 words of memory	10,500
	CRT DISPLAY OPTIONS	
SLM-1	15-in. CRT additional display monitor (addition of MCI-1 makes unit independently addressable)	2,300
SLM-2	17-in. CRT additional display monitor (addition of MCI makes unit independently addressable)	2,750
SLM-3	21-in. CRT additional display monitor (addition of MCI-1 makes unit independently addressable)	3,750
SLM-4	21-in. 4-color CRT display monitor includes interface and 15 feet of cable (in addition to 15-in. CRT supplied)	27,000
MON-1	17-in. CRT instead of standard 15-in. CRT (incremental cost)	890
MON-2	21-in. CRT instead of standard 15-in. CRT (incremental cost)	1,600
MON-3	21-in., 4-color CRT display in lieu of the standard 15-in. CRT (incremental cost)	26,000
PHO-12	Optional P-12 phosphor instead of standard P-39	260
	DISPLAY PROCESSOR OPTIONS	
GRP-1	Graphic hardware expansion package (includes LVH-1, MDS-1, and SGR-1)	2,550
GRP-2	High-speed graphic hardware package (includes LVH-2, MDS-1, and SGR-1)	3,675
SRT-1	Programmable two-dimensional scale, rotate, translate, and window module for all graphic entities	5,200
MIC-1	Manual image control for image magnification and positioning	950
MDS-1	8-Level display subroutine hardware feature	575
SRG-1	Fast X, Y vector generator (suppressed grid)	550
ASG-1	Auto incrementing suppressed grid plotting	650
PPM-1	Fast point plot mode	860
CPI-1	Interface only for 4-color CRT display CPS-8001 or equal	2,100
MCI-1	Monitor control interface (for up to four independent display monitors)	800
LVH-1	Long vector generation hardware	2,200
LVH-2	High-speed long vector generation hardware	3,050
	MINI-COMPUTER OPTIONS	
MEM-1G	Memory module 4K (factory installed)	2,900
MEM-2G	Memory module 8K (factory installed)	4,500
MEM-3G	Field upgrade of a 4K memory module	3,300
MEM-5G	Field upgrade of 8K memory module	4,900
ROM	Read-only memory bootstrap	370
CON-1	Programmer/maintenance control panel	1,500
IEI-1	16-bit parallel programmable I/O with external interrupt	580
DSH-3	Switch & electronics to allow either of 2 PDS-1Gs to be master or slave	500
	PERIPHERAL INTERFACES & DEVICES	
ASR-1	Printer, keyboard, paper tape reader and punch unit	5,000
CBS-1	Read/write cassette	890
PTR-1	IMLAC paper tape reader interface	685
TRD-1	High-speed paper tape reader (300 cps)	1,890
PTP-1	Facit paper tape punch interface	685
TPH-1	High-speed paper tape punch (75 cps)	2,400
MTS-1	Magnetic tape controller and one MTU-1 tape transport	10,490
MTS-2	Magnetic tape controller and one MTU-2 tape transport	9,500
MTS-3	Magnetic tape controller and one MTU-3 tape transport	12,500
MTU-1	Magnetic tape transport, 9-track, 10.5-in. reel, 800 bpi, 37-1/2-in. ips recording rate, NRZI	6,100
MTU-2	Magnetic tape transport, 9-track, 7-in. reel, 800 bpi, 12-1/2-in. ips recording rate, NRZI	4,725
MTU-3	Magnetic tape transport, 9-track, 10.5-in. reel, 1600 bpi, 25-in. ips	7,000
DSC-1	Disc file controller controls up to 4 DSF-2 or DSF-3 disk drives	4,400
DSF-2	Disk drive, 5M bytes IBM-2315-type removable cartridge plus a non-removable recording surface	8,300
DSF-3	Disk drive double density, 10M bytes	9,800
DSF-1C	Disk file cartridge for use with DSF-2 or DSF-3	195
HCY-3	Graphic hardcopy device	6,275
PRT-3	Low-speed serial impact printer, 30 char/sec	4,885
PRT-4	Low-speed line printer, impact type, 70 lpm	3,675
PRT-6	Raster Printer/Plotter, Electrostatic type, print mode; 500 lpm maximum	14,595
PRT-7	Raster Printer/Plotter Interface	3,675
	GRAPHIC DISPLAY SYSTEM	
PDS-4	The basic PDS-4 system includes a general-purpose 16-bit minicomputer with 4,096 16-bit words of 990-nanosecond memory (expandable to 32K words); display processor which shares memory with minicomputer; refreshed 17-in. diagonal CRT; alphanumeric keyboard with 67 keys including 6 user-definable function keys; communications modem interface; and read-only memory (ROM) bootstrap for program loading	17,300
PDS-4-8	Includes all basic PDS-4 features plus an additional 4,096, 16-bit words of memory	18,900
PDS-4/L	Includes all basic PDS-4 features plus 16K of core memory expandable to 64K in 16K increments.	22,700
PDS-4/SL	A 16K, PDS-4/L configured primarily for stand-alone or application development requirements. Standard features of a PDS-4/SL are an ex-	32,800

PRICE DATA (Contd.)

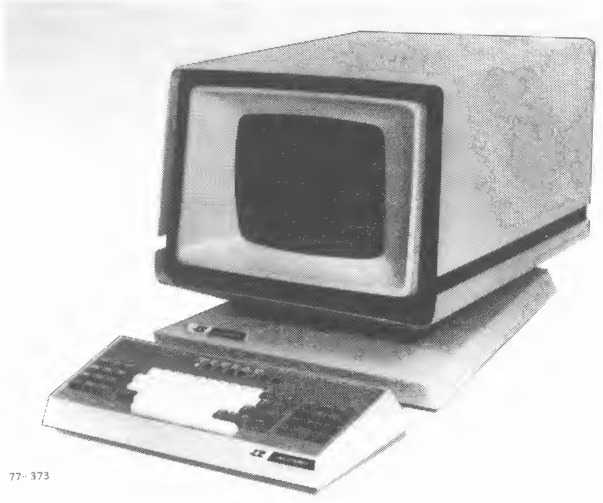
Model No.	Description	Purchase Price (Maint. not incl) $
	panded keyboard, 21" monitor (in place of 17-in.), Joystick and Flexible Diskette. The system is expandable to 64K core memory in 16K increments.	
PDS-4/DL	Similar to PDS-4/L except that system includes 21-in. monitor, extended keyboard, and 2-D rotational hardware (rack mount version only, includes RCK-41).	31,200
	DISPLAY MONITOR OPTIONS	
SLM-41	Additional slave display monitor, 15-in. CRT/diagonal with 15 feet of cable	2,450
SLM-42	Additional slave display monitor, 17-in. CRT/diagonal with 15 feet of cable	2,890
SLM-43	Additional slave display monitor, 21-in. CRT/diagonal with 15 feet of cable	3,950
SLM-45	Additional 17-in., 4 color CRT Display Monitor, includes interface and 15 feet of cable	16,900
SLM-46	Additional 21-in., 4 color CRT Display Monitor, includes interface and 15 feet of cable	18,500
MON-42	21-in. CRT display monitor, in lieu of standard 17-in. monitor	1,680
MON-44	17-in., 4 color CRT Display Monitor, in lieu of standard 17-in. Monitor, includes interface and 15 feet of cable	15,700
MON-45	21-in., 4 color CRT Display Monitor, in lieu of standard 17-in. Monitor, includes interface and 15 feet of cable	17,300
PHO-41	Optional P-41 Phosphor instead of standard P-39	275
	DISPLAY PROCESSOR OPTIONS	
CRG-41	Circle/arc generator	2,950
SRT-41	Graphic manipulation module	5,200
CPI-41	Interface for 4-color CRT display (CPS-8001 or equal)	2,300
KRI-41	Interface for 4 color CRT Display	2,300
MCI-41	Monitor control interface	850
MIC-41	Manual image control	950
MIC-42	Repeater for slave display	400
PPM-41	Fast point plot mode	900
	MINICOMPUTER OPTIONS	
MEM-41	Memory module 4K, 16-bit words (factory installed)	2,900
MEM-42	Memory module 8K, 16-bit words (factory installed)	4,500
MEM-43	Field upgrade of 4K, 16-bit word memory module to 8K module or field upgrade of 4K module (includes installation)	3,300
MEM-45	Field upgrade of 8K memory module, includes installation	4,900
MEM-46	Memory Module 16K, 16-bit words (factory installed)	6,500
CON-41	Programmer/maintenance control panel (utility and diagnostic software are supplied only when this unit is ordered)	1,500
DMA-41	Direct memory access channel (first device)	1,000
DMA-41-F	Direct memory access channel (field upgrade, standard installation charges apply)	1,300
DMA-42	Direct memory access channel for each additional device; includes backplane wiring, control and data buffering logic, and 2 20-foot cables with terminating connectors (up to 3 DMA-42s can be included in a system)	790
DMA-42-F	Direct memory access channel for each additional device (field upgrade, standard installation charges apply)	1,100
ROM	Additional or special read-only memory bootstrap program cards	385
RMX-41	ROM switch to select one of up to 4 total ROMs (extra ROMs not included)	500
IEI-41	Programmed I/O for 16-bit parallel data transfer, interrupt driven includes backplane wiring, data buffering, logic, and a 20-foot cable with terminating connector; up to 4 IEI-41s may be included in a system including those provided with each DMA channel	580
ACI-41	Real-time clock	890
PMP-41	Programmable memory protect	1,200
FPM-42	Floating point arithmetic module	9,500
DSH-44	Installation of a DSH-44 in a PDS-4 makes it a "main" machine in a Disk Share system. This allows its disk resources to be used by a satellite PDS-4. Only one DSH-44 can be installed in a PDS-4.	2,000
DSH-45	When installed in a "main" machine, DSH-45 allows additional satellite (2nd or 3rd) to use disk resources of "main" machine in a Disk Share system. Each satellite must have DSH-46.	1,260
DSH-46	When installed in a PDS-4, allows it to become a satellite in a Disk Share system and use the disk resources of the "main" machine. DSH-46 allows connection to the DSH-44 or DSH-45 cable.	1,260
	PERIPHERAL INTERFACES AND DEVICES	
ASR-41	Printer, keyboard, paper tape reader and punch unit	5,000
CBS-41	Read/write cassette	890
PTR-41	Paper tape reader interface	750
TRD-41	High speed paper tape reader	1,890
PTP-41	Paper tape punch interface	750
TPH-41	High-speed paper tape punch, 75 char/sec, tabletop unit	2,850
MTS-41	Magnetic tape controller and one MTU-41 tape transport	10,890
MTS-42	Magnetic tape controller and one MTU-42 tape transport	9,900
MTS-43	Magnetic tape controller and one MTU-43 tape transport	12,900
MTU-41	Magnetic tape transport, 9-track, 10.5-in. reel, 800 bpi, 37-1/2-in. ips recording rate, NRZI	6,500
MTU-42	Magnetic tape transport, 9-track, 7-in. reel, 800 bpi, 12-1/2-in. ips recording rate, NRZI	5,125
MTU-43	Magnetic tape transport, 9-track, 10.5-in. reel, 1600 bpi, 25-in. ips recording rate, phase encoded	7,400
DSC-41	Disk file controller, can accept up to 4 DSF-42s or DSF-43s disk drives	4,400

PRICE DATA (Contd.)

Model No.	Description	Purchase Price (Maint. not incl) $
DSF-42	Disk drive, 5M bytes; IBM-2315-type removable recording surface	8,500
DSF-43	Disk drive double density; same as DSF-42 except capacity is 10M bytes	9,800
DSF-41C	Disk file cartridge; for use with DSF-42 or DSF-43	195
DSF-42C	Disk File Cartridge for use with DSF-43. Includes verification of cartridge.	195
FDS-41	Floppy disk system (dual drive). Includes controller, interface, and up to four IBM 3740-compatible drives	7,900
FDD-41	Additional floppy disk drive (up to 4 per system)	1,200
HCY-43	Graphic hardcopy device	6,700
HCY-42	Multiplexor for connecting hardcopy unit to additional PDS-4 system	700
HCY-44	Interface & 20-foot cable for connecting each additional PDS-4 to HCY-42.	500
PRT-43	Low-speed, serial impact printer; 30-char/sec, 96-character font standard, 132 print columns with variable character spacing; changeable type face available; includes interface and 20-foot cable	4,885
PRT-44	Low-speed, impact line printer; 70 lpm, 60-character font, 5 x 7 dot matrix, 80 print columns with pen feed; includes interface and 20-foot cable	3,675
PRT-46	Raster printer/plotter with interface print mode; 500 lpm maximum, 96 char/set, 132 print columns (11 in. wide)	15,595

INCOTERM CORP

SPD 10 Family of Intelligent Terminals



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OVERVIEW

The Incoterm SPD 10 Family consists of the SPD 10/20 and 10/25, the IBM 3275-compatible SPD 325, and the SPD 904 series of remote batch terminals, which are intelligent terminal systems composed of a miniprocessor, CRT, and keyboard. They are marketed as stand-alone intelligent data entry systems; terminals for PARS airline reservation systems; 3275 replacement terminals; remote batch terminals; and as multiplexor/concentrators for nonintelligent terminal systems. Both synchronous and asynchronous communications of up to 9,600 bits per second are supported.

As the intelligent terminal market matures, individual vendors are developing more sophisticated software in order to remain competitive in the intelligent terminal market and take on some of the functions that have traditionally been assigned to the stand-alone small business computer. The SPD 10 Family offers standard software packages for terminal emulation and remote batch terminal support, in addition to an SPD assembly language and an SPD diskette operating system (DOS) for writing application programs. Both the assembler and DOS feature an editor, debug, and other utilities.

The features which distinguish the SPD 10/20 from the SPD 10/25 are centered around the operator's display screen and keyboard. The SPD 10/20 displays 64 characters per line, while the SPD 10/25 displays 64 or 80 characters per line. Screen refresh memory for the 10/20 is 2K bytes of program (core) memory which leaves only 2K bytes of memory for user programs. Screen refresh memory for the 10/25 is MOS random access memory (RAM) that is not part of the program memory. This arrangement leaves the full 4K bytes of memory for user programs.

The SPD 10/25 may be configured with two keyboards per I/O channel, while the 10/20 can be configured with only one keyboard per I/O channel. Each display station on the 10/25 may be placed up to 2,000 feet from the Terminal Processing Unit. See Table 1 for 10/20 and 10/25 system specifications.

The SPD 325 is a specialized version of the SPD 10/25, designed as a remote stand-alone version of the SPD 320 and a direct replacement for the IBM 3275 Information Display System. The system may be configured as a single- or dual-station arrangement. A choice of three display screen sizes are available, namely, 480, 960, and 1,920 characters.

In addition to the 10/20 and 10/25's intelligent terminal capabilities, they can also be configured as remote batch terminals. When operating as the SPD 904 RBT, the 10/20 or 10/25 is configured with a card reader and matrix printer. Optionally, it can be configured with a printing card reader/punch.

COMPATIBILITY

The Incoterm SPD 10 Family is hardware- and software-compatible with IBM System/360, IBM System/370, and Univac 1108 computer systems.

Software simulation packages are available for most major mainframe manufacturers' terminal equipment. These include nearly all IBM terminals, Uniscope 100 and 200, Harris 620, and Burroughs TC 500/700. The programmable capabilities of the SPD 10/20 allow the addition of other simulation packages.

The expanded character set option allows compatibility with the character sets for IBM 1050, 2260/65, 2740/41, and 3270 terminals.

HEADQUARTERS

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Table 1. Incoterm SPD 10/20 and 10/25: Specifications

	SPD/10/20	SPD 10/25
Miniprocessor		
Memory Size (bytes)	4K (2K user prgmble; 2K screen refresh)	4K (4K user programmable; 4K screen refresh)
Word Size (bits)	8	8
Cycle Speed (msec)	1.6	1.6
Transmission Code	Any 5 to 8-bit code	Any 5 to 8-bit code
Max I/O Devices	8 controllers	7 controllers plus 1 for screen refresh buffer
Utilities	Assembler, diskette operating system (SPD DOS)	Assembler, diskette operating system (SPD DOS)
Peripherals		
Magnetic Tape	Opt 7-, 9-track	Opt 7-, 9-track
Printers (cpm)	15–165 cps; 125–300 lpm	15–165 cps; 125–300 lpm
Punch Card (cpm)	45 to 75	45 to 75
Disk	Floppy disk "diskette"	Floppy disk "diskette"
Card Reader (cpm)	200, 250, 500 cpm	200, 250, 500 cpm
Data Communications		
Line Interface	Sync or async	Sync or async
Control Procedures	IBM BSC	IBM BSC
Standard Features	Remote loading; Auto Exec	Remote loading; Auto Exec
Optional Features	Programmable	Programmable
Display Unit		
Screen Size (char)	960; 1,920	960; 1,920; 2,000
Characters per Line	64	64; 80
Lines per Display	15, 30	12; 15; 24; 25; 30
Character Set	64 std; 121 opt (U/L case)	64 std; 121 opt (U/L case)
Character Generation	7x10 dot matrix std; 8x14 opt	7x10 dot matrix std; 8x14 opt
Data Transmission		
Network	Leased; switched	Leased; switched
Line Speed (bps)	Async/sync; up to 9,600	Async/sync; up to 9,600
Error Control	LRC; parity	LRC; parity
Compatibility		
Computer System	IBM 360; 370; Univac 1108	IBM 360; 370; Univac 1108
Terminals Emulated	Uniscope 100; RCA 751/752; Burroughs	IBM 3270; Uniscope 100; RCA 751/752; Burroughs
Bell Data Set	103; 201; 203; 208	103; 201; 203; 208
First Delivery	June 1970	November 1974

PERFORMANCE AND COMPETITIVE POSITION

The SPD 10/20 and 10/25 compete primarily in three markets as:

- Intelligent terminals.
- Replacement and emulation terminals.
- Remote batch terminals.

Intelligent Terminals

The SPD 10/20 and 10/25 are being used more frequently as stand-alone devices. A full line of peripherals and an assembler which is available for user programming make the 10/20 and 10/25 competitive with intelligent terminals offered by Sycor, Harris, Mohawk, Data Sciences, Burroughs, and ICL.

Replacement and Emulation Terminals

The SPD 10/20 has successfully competed against the special-purpose IBM 2915 terminal and has had excellent acceptance for PARS (airline reservation) systems. It is cost effective because it has useful features such as the SPD-M Terminal Multiplexor, and it reduces data communications costs. Replacement terminal applications probably account for two out of every three installed SPD 10/20s.

As an IBM 3270 emulator, the Incoterm terminals have joined the growing list of firms in the 3270-compatible marketplace. Following the pattern of Four-Phase Systems and Raytheon, Incoterm has entered the market with a software emulation package for an existing general-purpose programmable terminal system.

Remote Batch Terminal

Early in 1973, Incoterm announced the SPD 904 RBT Series. The basic configuration consists of an SPD 10/20 or 10/25 card reader and a matrix printer.

As the "pure" remote batch terminal is fast becoming a thing of the past, Incoterm has joined other manufacturers such as Harris and Four-Phase Systems, who have also incorporated RBT emulators and peripheral equipment with existing intelligent terminals to allow the terminals to function as both interactive data entry and remote batch systems.

USER REACTIONS

The flexibility of Incoterm's SPD 10/20 and 10/25 is highlighted by the variety of user applications. We discovered SPD 10/20 and 10/25 terminals being used for file inquiry and maintenance at a savings and loan service

corporation, as part of an extensive network for passenger airline reservations, as a control device and editing tool for a financial news service, and as interactive remote stations communicating with a central information bank for a major newspaper.

All users are impressed with the price/performance ratio of the terminals; the dual configuration is particularly efficient. Users lauded the ease of programming and termed it a deciding factor in purchasing the Incoterm over Burroughs, Harris, Sycor, or Four-Phase terminals.

Savings and Loan

The savings and loan service corporation uses 25 Incoterm SPD 10/20 terminals as an on-line accounting service to handle inquiry and file maintenance, new account entries, and alphanumeric changes (name, address) for Virginia, Maryland, and North Carolina. The terminals are emulating the Burroughs TC 700 terminals which are hooked up to a Burroughs B 3500 computer on a leased, private line, using a Burroughs half-duplex modem. Some of the terminals are used in a dual configuration. Aside from price/performance and the ease of programming, this company selected the Incoterm terminal because of its ability to operate at 1,800 baud with the Burroughs modem.

Airline

The major airline is using 1,200 Incoterm terminals, 454 in dual configurations, to operate a passenger reservation system. The terminals have been modified to run ticket printers.

News Service and Newspaper

The financial news service uses two terminals for text editing, one for programming, and a fourth as a spare. Some of its terminals have extended memory. The company has had minor problems with tape alignment and punched cards not seating properly, but the company spokesmen admit possibly overtaxing the system with nonstop use. The company also uses Raytheon PTS-100 terminals; and, while it finds them dependable, it finds that the Incoterm terminals are easier to program and have a more compact data structure.

The major newspaper has programmed the SPD 10/20 to emulate modified IBM 2770 terminals in remote locations. This company found the Incoterm terminals to be effective total units, meeting its software, communications, and price requirements.

CONFIGURATION GUIDE

The SPD 10/20 and 10/25 are complete units that can interface with a variety of peripherals. The processor can directly address eight I/O controllers.

Two communications controller types (synchronous and asynchronous) provide the complete interface between the SPD 10/20 and 10/25 and a communications line. Each operates in half-duplex mode. Two controllers are used for the full-duplex mode.

Character parity checking is provided by hardware, while longitudinal redundancy checking is a software option. A hardwired cyclical redundancy check feature is available.

The SPD-M Multiplexor interfaces the SPD 10/25 to a single modem and communication line or, alternatively, to another multiplexor unit. Figure 1 shows a cascaded configuration of SPD 10/25 systems. The SPD-M Modem Multiplexor Units allow up to eight (16 optional) terminals to use a single modem, which can save modem and controller costs. They allow point-to-point or multidrop operations. The SPD-M directly interfaces to Bell Series 103, 201, 203 and 208 modems.

Incoterm also has a Party Line Controller option to provide inhouse communications between clustered CRTs at up to 9,600 baud without modems. Suggested applications include shared printers, magnetic tapes, diskettes, and monitoring functions.

Processor. The processor is byte-oriented and single address. It has a 4K-byte core memory with a cycle time of 1.6 microseconds. A data word is one byte in the processor and two bytes in memory. There are three user registers: accumulator, character, and line. Execution time is 3.2 microseconds for add, subtract, branch, compare, and jump instructions.

CRT. The CRT has a 12-inch diagonal screen with a viewing area that is 9.5 inches wide by 6.5 inches high. Character generation is via a 7 x 10 dot matrix; 64 or 80 characters are displayed per line.

An optional expanded 121-character set provides upper- and lowercase compatibility for English, German, and Swedish alphabets. Data codes are available for EBCDIC, BCD, and ASCII.

Keyboard. The keyboard is Qwerty, alphanumeric, typewriter keys. It has eight status lights and 24 function keys (48 with shift). An unusual feature of the SPD 10/20 keyboard is that every key is under software control. Thus, the depression of any key generates an interrupt, which in turn initiates a software routine; as a result, keyboard operation can be customer specified. Normal Incoterm operating procedure is to write the necessary software for the customer prior to delivery. Incoterm states that many customers have chosen to write their own software, however.

Optional Peripheral Devices

The SPD 10/20 and 10/25 can be configured with any of the following devices:

- Printers.
- Diskette.
- Paper Tape.
- Dual Display System.

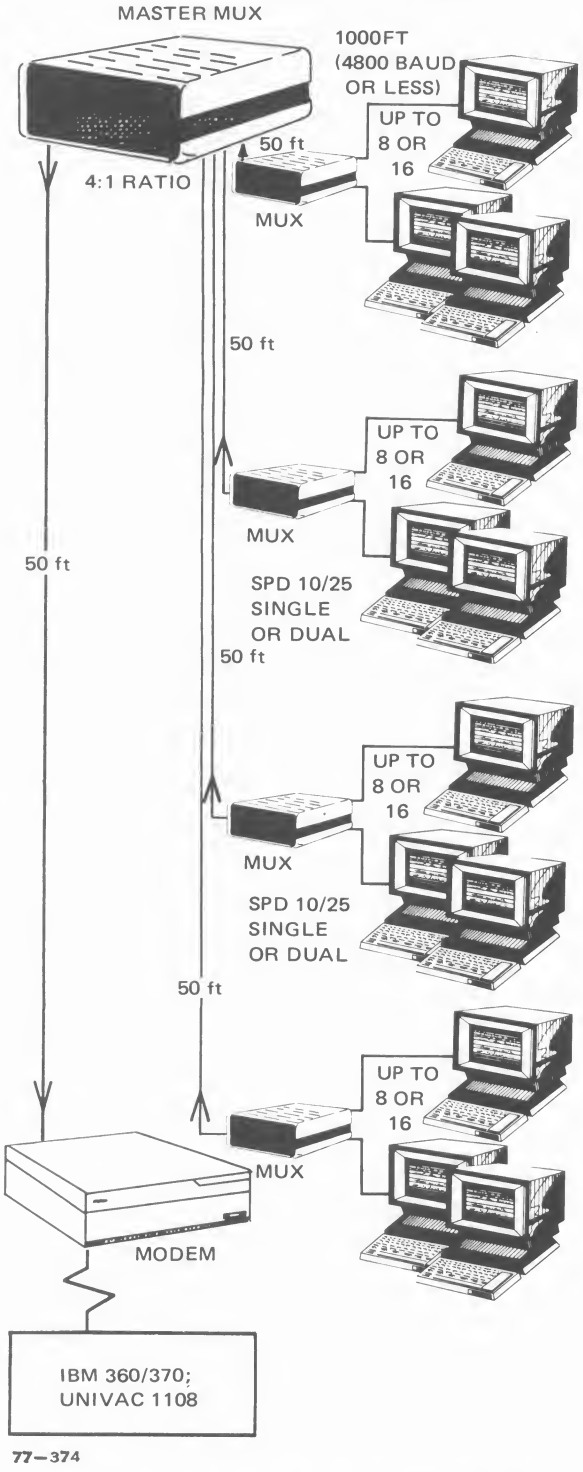

Figure 1. SPD-M Multiplexor Cascaded Configuration

Printers. Incoterm offers the SPD P165B, a self-contained unit that includes all necessary electronics, line buffer, power supply, and vertical format control. It prints at 165 characters per second on 5-part positions; spacing is six lines per inch.

The SPD-P100 is an impact printer that prints 100 characters per second on 5-part paper, an original and four copies. The line has 80 print positions; spacing is six lines per inch.

Diskette. The D-251 floppy Diskette System is a compact, direct access, removable disk unit. It is available either as the SPD D-251 single-disk unit or the SPD D-251D dual-disk unit. The D-251 is a self-contained system consisting of drive, read/write head, disk controller unit, control panel, power supply, and associated electronics. The D-251 interfaces to a controller board in the SPD 10/20 or SPD 10/25.

The D-251 has a 262K byte capacity (per disk); transfer rate is 62,000 bytes per second. Recorded data is write protected on an individual device basis. Device interlocks prevent damage to a disk during loading or unloading. The D-251 contains a buffered controller to allow background operation.

The D-251 system is supported by a disk operating system. SPD DOS is resident on diskette to allow entry and recall of disk records.

Paper Tape. DTR-150 paper tape reader speed is 150 characters per second. This unit is used to load programs and/or data in bootstrap mode or under program instructions.

Dual Display. The dual-display unit provides two displays and two keyboards, under control of one processor. The primary advantage of this arrangement is its economy. Two operators can be at work on independent tasks for much less than the cost of two terminals. Also, only one modem is required, with no multiplexor. With a multiplexor, dual terminals can be grouped to form clusters of up to 32 stations. This arrangement also uses only one modem.

SOFTWARE

Application software is written for the SPD 10/20 and 10/25 on an individual basis using Assembly language.

The SPD/DOS Diskette Operating System is available for those systems equipped with the SPD D-251 flexible diskette. The SPD/DOS includes the following:

- File update and control for source, object, and data files.
- Utilities for file maintenance.
- Assembler for program preparation.
- Dump debug and edit capability for program development.

- Source and object program input from a variety of media.
- Assembler/loader facilities for multiple segment overlay programs.

Other software features for the SPD 10/20 and 10/25 include a program loader (which accepts assembler output and loads it into core memory), and a debug program.

MAINTENANCE

On-site maintenance is available from a field service organization of nationwide service centers.

Maintenance is available through a separate contract for lease. Purchased systems carry a 90-day warranty with an optional contract available for continuation of maintenance. System engineering support is available at offices located in major U.S. cities.

PRICE DATA

Description	Monthly Rental (Incl Maint) $	Purchase Price $	Monthly Maint. $
SPD 10/20			
Basic Configurations:			
SPD 10/20 Single W/one comm interface	215	6,090	40
SPD 10/20 Dual W/one comm. interface	270	7,875	51
Peripherals:			
Diskette			
Single Drive	NA	2,835	40
Dual Drive	NA	3,890	40
Printers			
15 cps	129	2,945	35
100 cps	140	3,145	40
165 cps	161 to 221	3,790 to 5,220	40 to 55
125 lpm	NA	8,680	75
250 lpm	NA	11,440	100
300 lpm	NA	13,200	135
Card I/O			
250 cpm Reader	NA	2,675	50
500 cpm Reader	NA	2,925	65
Modem MPX			
4-Channel	77	1,840	22
8-Channel	77	2,205	22
16-Channel	102	2,995	27
Paper Tape Reader	60	950	15
Party-Line Controller	21	465	6
Exp Char Set	15	235	NC
Remote Load Controller	11	235	2
Audible Alarm (Sonalert)	5	25	NC
Industry-Compatible			
Mag. Tape Drives			
7-Track	NA	7,575	80
9-Track	NA	7,575 to 9,275	80
SPD 10/25			
Basic Configurations			
SPD 10/25 Single W/one comm. interface, 1,920 char screen	240	7,405	40
SPD 10/25 Dual W/one comm. interface			
—960 Char	305	9,030	50
—1,920 Char	310	9,295	50
Peripherals:			
Same as 10/20 set			

Note:
NA= Not applicable
NC= No charge

INCOTERM CORP

SPD 20 Family of Intelligent Terminals

OVERVIEW

The Incoterm SPD family are programmable, clustered CRT terminal systems designed for a variety of data entry and related data processing functions; they support data transmission with remote processors. The SPD family consists of Models 20/20, 20/30, 20/40; Models 20/20 and 20/30 can support from 8 to 16, 1,920-character CRTs; and Model 20/40 supports from 16 to 32, 960-character CRTs. Core memory capacity ranges from 16K to 64K, and up to 1.5M bytes of flexible disk or up to 40M bytes of cartridge disk capacity are offered. The 16-bit processor that controls the system has a 1.6 microsecond cycle time. SPD 20 terminals communicate synchronously or asynchronously, in full- or half-duplex modes, at speeds up to 9,600 bps. Communications compatibility with IBM 360/370 and Univac 1108 computer systems is provided. In addition, software is available to allow emulation of the IBM 3270, Univac 100, Honeywell VIP 7700, and Burroughs TD 820. See Table 1 for model differences.

Included in Incoterm's software offering for the SPD 20 family are a diskette-operating system (SPD/DOS), a standard assembler running under Incoterm's DOS, and cross-assemblers that can run on large-scale computers.

Incoterm's Data Entry Software (IDES) is a combined remote job and data entry system which emulates the IBM 2780 and provides local forms storage recall, local data entry, and the transmission of locally stored data to a central computer. IDES supports up to eight local display stations and printers. Remote batch terminal and PARS (Passenger Airline Reservation System) emulation are also provided with the SPD 20 models.

Table 1. Incoterm SPD 20 Family: Model Configurations

	20/20	20/30	20/40
Processor			
Main Memory (bytes)	6K-32K	16K-64K	32K-64K
Max No.Displays	16	32	32
Peripherals			
Cassette	Yes	No	No
Magnetic Tape	Opt	Opt	Opt
Printers (up to 16)	15, 100, 165 cps; 125, 250, 300 lpm	15, 100, 165 cps; 125, 250, 300 lpm	15, 100, 165 cps; 125, 250, 300 lpm
Disk	Floppy: .25M-1.5MB	Floppy: .25M-1.5MB	Cartridge: 10M-40MB
Card Reader (cpm)	250 or 500	250 or 500	250 or 500
Card Punch (cpm)	45-75	45-75	45-75
Software			
SPD/DOS	Yes	Yes	Yes
Assembler	Yes	Yes	Yes
Emulation (3270, U100/200, VIP 7700, TD 820)	Yes	Yes	Yes
3270 Emulation/ LFC	Yes	Yes	Yes
PARS	Yes	Yes	Yes
RBT Emulation	Yes	Yes	Yes
BASIC	No	Yes	Yes
IDES	No	Yes	Yes
PD/FMS	No	No	Yes

Additional software is offered with the Models 20/30 and 20/40 systems. The Incoterm BASIC language compiler provides a Model 30 or Model 40 system with a BASIC language programming capability. The Incoterm Data Entry Software (IDES) Level II provides both the systems with all of the capabilities of the IDES Level I; in addition, it provides inquiry response to the host and supports four dual diskette units. The Models 40 system also includes software for program development, using cartridge disks — the Program Development/File Management System (PD/FMS).

Many of the peripherals originally offered with Incoterm's SPD 10/20 and 10/25 can be used on the SPD 20 family. Peripherals common to all three systems include six models of printers, magnetic tape drives, and card readers. See Table 1 for SPD 20 model configurations; Table 2 presents the specifications.

Incoterm's first intelligent terminal, the SPD 10/20, was first delivered in 1970; it has been successful as a replacement system for the IBM 2915 terminals used in PARS airline reservation systems. The SPD 20/20 multi-station system was first delivered in April 1974. To date, over 2,625 systems have been installed. The SPD 20/30 and 20/40 systems were first delivered in late 1976.

Table 2. Incoterm SPD 20 Family: Characteristics

Processor	
Word Length (bits)	16
Cycle Time (μsec)	1.6
Display Unit	
Screen Size	960, 1,920
Characters per Line	64, 80
Lines per Display	15 or 30, 12 or 24
Character Set	64 std, 128 opt
Character Generation	7 x 10 dot matrix, 8 x 12 opt
Data Transmission	
Line Facility	Leased, switched
Line Speed (bps)	Up to 9,600
Line Mode	HDX/FDX
Line Code	Any 5- to 8-bit
Synchronization	Async, sync, BSC, SDLC
Interface	RS-232C
Error Control	LRC, parity
Compatibility	
Computer System	IBM 360/370, Univac 1108
Terminals Emulated	IBM 3270
Bell System Data Set	201, 202, 208
First Delivery	1974 (20/20), 1976 (20/30 & 20/40)

PERFORMANCE AND COMPETITIVE POSITION

In terms of hardware, the SPD 20 family competes with IBM's 3790 Communications System (especially with its 3760 key-to-disk configuration). Datapoint's 2200 and 5500 processor small business systems, Four-Phase's System IV/40 and IV/70, Raytheon's PTS/1200 System, and Texas Instrument's DXS 20 and 40 which are all aimed at the distributed processing market. Whether or not one chooses to consider the preceding machines "distributed processing systems," they share certain functional characteristics that distinguish them from their intelligent terminal counterparts. These characteristics or qualities are:

- Large clustered configurations usually tailored for the distributed applications of individual companies. The manufacturers usually search out companies with many branch offices that need equipment for local data entry and document preparation.
- Independent computational processing capability.
- An ever increasing auxiliary disk capacity size.
- Uneven offerings of data entry software and programming languages (Assembly for IBM, BASIC, RPG II, and Assembly for Datapoint; COBOL for Four-Phase; Macrol Assembly for Raytheon; and DXS/ST, a COBOL-like language, for Texas Instruments).
- Usually no turnkey or packaged software is available, except in the case of Datapoint's 2200 and 5500 small business systems.

The SPD 20 Family is probably more at home competing with clustered intelligent terminals, where, equipped with its data entry software, it competes in the high-end of the market. Here it competes with such systems as the Sycor 440, Harris 800 and 8000 Series, Braegen's Virtual Terminal System (formerly CalComp), and ICL's 1503 and 7500.

USER REACTION

A southern metropolitan hospital, which has been gradually installing Incoterm SPD 20/20s for one and a half years, currently has 14 eight-station terminal clusters. Configured around two Burroughs medium mainframes, the B3700 and B3500, the 20/20 terminals are used on-line for a wide range of applications. These include business office applications such as admitting and accounting, as well as nursing applications at nursing stations throughout the hospital. No local file processing is done by the 20/20s, but editing and validation of outputs and formatting of inputs are performed. A spokesman said that the hospital has used the Incoterm SPD 10 terminals for over six years, and decided on the 20/20s because of their programmability. What he liked best about the systems was that their programmability translated into user application flexibility which was important for the hospital's many application needs. Although the spokesman said he was very pleased with the units, he noted that one inconvenience for him, in terms of short-term planning, was that a user has to deal in clusters of eight for the most cost-effective system, and sometimes he has needed fewer workstations. This user did not employ the Incoterm software but wrote his own in order to develop software expressly for his requirements. He stated that maintenance support has been good and that the terminals have been quite reliable.

A public utilities company in the Northeast has had eight SPD 20/20s for about two and a half years. Used for accounting applications, bill inquiries, and meter and service order printing, the remote Incoterm terminals are configured around an IBM 145 with CICS. All processing is carried out by the CPU. The company originally considered only Raytheon and Incoterm terminal systems, because at that time they were the only intelligent terminal companies which allowed inhouse testing of their terminals. The Incoterm SPD 20/20s were selected because of their software capabilities. Benefits of the systems which this spokesman recalled include its nonglare screen, its programmable lights on the keyboard which indicate to the user when a message is being transmitted, and the display's feature of presenting data from the buffer one line at a time. The spokesman noted that his company selected the Incoterm models because of their programmability; however, in talking to other users he found that few have taken advantage of it. The lack of software acceptance is of concern to him. The utility's spokesman experienced very little downtime and is generally happy with the units.

CONFIGURATION GUIDE

The SPD 20 terminals differ in the amount of main memory they provide, in the number and size of their CRT terminals, and in the amount of mass storage they offer. The Model 20/20 offers 16K bytes of program memory as standard and 16K bytes optional, with optional diskette storage of up to 1.5M bytes. The Model 20/30 provides up to 16K bytes of program memory as standard, with 48K bytes optional; diskette storage of 0.25M bytes as standard and 1.25M bytes optional. The Model 20/40, the top-of-the-line model, includes up to 32K bytes of program mem-

ory as standard and 32K bytes optional, with cartridge disk storage of up to 40M bytes. Maximum display cluster sizes range from eight 1,920-character CRT keystations for the Model 20/20 to thirty-two 960-character CRT keystations for the Model 20/40.

The SPD 20 systems may be upgraded or expanded to the next higher level Model. For example, a Model 20 can become a Model 30 or, ultimately, a Model 40.

Eight I/O channels are provided for communications adapters or for peripheral controllers for the connection of a diskette subsystem, 7- or 9-track magnetic tape subsystem, card reader, paper tape, and a cartridge disk subsystem (Model 20/40). The diskette subsystem controller connects one or two drives; other controllers support a single auxiliary storage device. See Table 1 for SPD 20 Family specifications.

Processor

The Terminal Processing Unit (TPU), which controls the display terminals, consists of the core memory, a real-time clock, the arithmetic logic unit, the input/output subsystem, and the refresh memory subsystem. The TPU is a parallel binary, byte-oriented computer. It uses a single-address instruction format with multilevel indirect addressing. The core memory, ranging from a minimum of 16K on the 20/20 to a maximum of 64K on the 20/40, has a cycle time of 1.6 microseconds. Each byte is individually addressable. Memory is divided into sectors of 512 bytes each; the number of sectors ranges from 32 to 64, depending on the configuration. The Arithmetic Logic Unit is a 16-bit parallel unit which performs arithmetic and logic operations on words or bytes. The add time is 1.6 microseconds for an immediate operand and 3.2 microseconds for an operand in memory.

The real-time clock is assigned the highest priority interrupt level; it interrupts the processor at a rate of 60 times per second. The clock is treated as a peripheral device for programming purposes.

Input/Output Subsystem

The I/O subsystem within the TPU consists of the hardware-controlled interrupt system, I/O control logic, and interfaces for communication and peripheral devices. Eight communications ports are available: one line is used for communications and processing in the typical configuration, and the other seven ports are available for peripheral attachments.

The AUTO-EXEC Interrupt System, implemented in software and transparent to the user, determines the device that caused an interrupt, saves and restores processor registers, requests specific I/O operations, and sequences routines to be run. AUTO-EXEC resides in the top sector of core, the Memory Reserve Area. For each device that can cause an interrupt, two words are reserved for register storage in the Memory Reserve Area. The TPU hardware determines the level of priority an interrupt receives. AUTO-EXEC can be controlled by instructions; thus the program can accept or inhibit interrupts, wait for interrupts, and reset interrupts.

Peripherals attach to the TPU by way of an associated controller. Communication controllers interface the processor to the communication lines through modems or SPD-M multiplexors. These controllers provide control logic to transfer data between peripherals or communication lines and the TPU. The SPD 20 terminals communicate with a host processor, other SPD 20 systems, or other communication devices in full- or half-duplex, synchronous or asynchronous mode, at 50 to 9,600 bps.

Refresh Subsystem

All necessary controls and interfaces to drive up to 16 or 32 displays are included in the refresh subsystem. The subsystem contains up to eight MOS dynamic Random Access Memory (RAM) banks to provide refresh memory for all display screens; thus the core main memory is free from this refresh task. Each bank stores 2K bytes of memory. The subsystem also contains up to 16 registers of 12 bits each for cursor control — one register for each display screen. The cursor is hardware-generated but software-controlled.

CRT

Two display consoles are available with the SPD 20 Family — the Standard and the Executive. Functionally, both are the same; the Executive has been repackaged into a smaller unit and offers an optional separate numeric keypad. While the typical configuration for the system is a keyboard and a display, the only system requirement is to have at least one keyboard per system.

The diagonally-measured 12-inch viewing monitor on both consoles has a nine by 6.5-inch viewing area. Characters are displayed in a seven by 10 dot matrix. The screen is etched to reduce glare and it uses green phosphor for easy viewing. The display's operating mode is dynamically selectable by software, rather than switch-selectable. Software also controls the centering of data on the screen.

Attribute characters define the characteristics of the following field on the display. They are the first characters in the field and normally are not displayed. An optional attribute character for the system is a protect/unprotect bit. If it is a 1, a vertical character is generated on the screen.

PERIPHERALS

Flexible Diskette

The SPD D-251 Flexible Diskette system consists of either one or two disk drives, a controller unit, control panel, and power supply. The D-251 interfaces with the SPD 20/20 or 20/30 terminal by means of a single-board disk controller placed in one of the TPU's I/O channel slots. Flexible Diskette Storage

is optional on the 20/20 and standard on the 20/30.

Total capacity of each disk cartridge is 262K bytes. A dual disk system provides a capacity of 524K bytes. Each cartridge has 64 tracks, with 32 sectors per track. The cartridges are totally interchangeable from unit to unit, providing read and write interchangeability. Read errors are detected by a cyclic check field; two bytes of redundant data are hardware-generated to detect errors. The buffer shared by both drives is 128 bytes of MOS static RAM. The standard write protect is switch-selectable from the front panel. The bootstrap loader handles up to a maximum of 2K bytes.

Magnetic Tape

The SPD-MT Half-Inch Magnetic Tape Subsystem consists of an ANSI- and IBM-compatible tape transport, controller, and tape formatter unit. There are six basic models, providing 7- and 9-track units, with a tape speed of 25 inches per second. Recording methods are NRZI for 556 and 800 bit-per-inch 7-track units, NRZI for 100 bit-per-inch, 9-track units, and PE for 1,600 bit-per-inch 9-track units.

The timing control logic, and power supplies are contained within the tape formatter unit. The magnetic tape controller is located within the TPU. High-speed storage and retrieval are protected by a 1K-byte buffer memory. Stored programs can also use this memory as a "scratch pad" when the tape is not performing terminal operations.

The SPD 20/20 includes a magnetic tape cassette unit for auxiliary storage and program loading. The unit is integral to the TPU and can be operated in automatic mode under stored program control or in manual mode under operator control. Commonly used programs are loaded from the tape to the TPU. Data is normally transmitted to or from the magnetic tape unit under program control. Software debug programs can also use the cassette to dump memory onto tape.

The cassette's recording density is 50 characters per inch, with a maximum capacity of 180,000 characters. Data transfer rate is 100 characters per second.

Cartridge Disk

A Cartridge Disk Storage Unit provides a 20/40 system with a standard 10M bytes of storage, expandable in 10M increments to 40M bytes. Standard packaging consists of one or two disk drives mounted in a cabinet; up to two cabinets can be combined for 40M bytes of storage.

Printers

Incoterm offers four impact printer models. All printers have a one-line buffer and use an ASCII set of 64 characters. The single-board controller occupies one I/O slot in the TPU. All impact printers use a 5 x 7 dot matrix (9 x 7 optional) and have parallel (up to 20-ft. cable) or serial (up to 2,000-ft. cable) interfaces. The serial models must use the multi-printer controller (MPC) option.

The SPD P-15B prints an original and up to three copies at a rate of 15 characters per second. It prints up to 72 characters per line.

The SPD P-100 printer prints 100 characters per second or 60 lines per minute on an 80-character line. Elongated characters can be printed under control of a specific code. This printer includes 2-channel vertical format control and automatic motor control.

The SPD P-120C prints 165 characters per second for a 132-character line or 100 characters per second for an 80-character line. Character spacing is either 10 or 16.5 characters per inch. The number of characters per line is switch-selectable. The P-120C has vertical format control and automatic motor control.

The SPD P-165B prints 165 characters per second or 55 (132-character) lines per minute. The printer has vertical format control and automatic motor control.

Line printers for the SPD 20 Family come in three models — 125 lpm, 250 lpm, and 300 lpm. All models have a 64-character ASCII code character set and a line length of 132 columns. They print an original and five copies. Parallel (up to 20-ft. cable) or serial (up to 2,000-ft. cable) interfaces are available on the line printers.

Card Readers

The CR250 reads standard 80-column cards at 250 cards per minute. The reader controller is housed in the TPU and occupies one I/O slot. Hopper capacity is 500 cards.

The CR500 is a high-performance reader designed for continuous use. It reads at a rate of 500 cards per minute and has a hopper capacity of 500 cards.

Paper Tape

The SPD PTR150 Paper Tape Reader operates at a rate of 150 characters per second. The loader transfers data and/or instructions in the bootstrap mode or in response to a read instruction from the TPU.

DATA COMMUNICATIONS

An SPD 20 communicates with front-end processors or other SPD 20 systems in full- or half-duplex mode. Synchronous or asynchronous communications are available at speeds up to 9,600 bits per second. ASCII and EBCDIC communications codes are supported. IBM 3270 emulation is offered and the 20 Family will also support IDLC, an Incoterm subset of the IBM SDLC protocol.

SOFTWARE

Software routines and packages for the SPD 20 Family are heavily communications oriented. IBM 3270 emulation with local forms control runs on the 20 Family systems configured with 32K bytes of core memory with the 20/20, or 64K bytes with 20/30 and 20/40, up to eight SPD 20/20 display terminals (or up to 16 SPD 20/30 and 20/40 terminals), up to three dual diskettes, synchronous communications, and 100- or 165-lpm printers. Programs for the SPD 20 Family can be developed using a 2-pass symbolic assembler which will run on an IBM System/360 or 370 under OS, on a Honeywell H316/516, and on a Burroughs B 2500/3500, as well as on Incoterm's SPD 20 Family's own disk-operating system (DOS).

All versions of the assembler generate absolute or relocatable code. The assembler can output object code on cards or tape, and it can generate a literal table, cross reference listing, and an assembled statement listing. The source program contains parameters to drop or include sections of code in the assembly listing process.

DOS is available for SPD 20 Family Models equipped with a flexible disk. Features of the Incoterm DOS system include:

- File update and control for source, object, and data files.
- Utilities for file maintenance.
- Assembler for program preparation.
- Dump, debug, and edit capabilities for program development.
- Source and object program input from a variety of media.
- Assembler/loader facilities for multiple-segment overlay.

Incoterm's Data Entry Software (IDES) Level II includes:

- An interactive forms editor program allowing the user to change forms from the diskette.
- A forms generation program — a language program with which forms are created.
- TGP — a program using standard utilities from which the user creates tables for validity checking, range checking, and translation.
- IDES — the actual standalone data entry program.

Operating under control of the SPD/DOS Disk Operating System, Incoterm's BASIC language compiler accepts user written source program statements into an object file. An SPD Assembler language program executes the BASIC language statements through an interpretation of the object file.

The Model 20/40 system provides a Program Development/File Management System (PD/FMS) for cartridge disk storage.

Incoterm's Transaction Entry Management System (ITEMS) is a virtual storage operating system which allows eight display stations and eight printers to be operated independently under the control of 16 concurrent programs. Capable of operating on Incoterm's Models 30 and 40 intelligent terminals, the programs are written in Transaction Definition Language (TDL), a high-level MACRO language. This software package allows distributed local processing with virtual storage, combined with interactive communications and batch storage at the user's option.

MAINTENANCE

On-site maintenance is available from an organization of 88 nationwide field service centers. Maintenance is available through a contract separate from the lease contract. Purchased systems carry a 90-day warranty with an optional contract available for continued maintenance. System engineering support is available at offices in major U.S. cities.

PRICE DATA

Description	Monthly Rental (Incl Maint) $	Purchase Price $	Monthly Maint $
Incoterm SPD 20/20 (16K Core Memory, Cassette, Communications Adapter, [1,920 Char Screen] & 76 Key Keyboard)			
4 Station	822	19,215	111
8 Station	1,189	27,835	159
Incoterm SPD 20/30 (16K Core Memory, Single Drive Diskette, Communications Adapter, [1,920-Char Screen] & 76 Key Keyboard)			
4 Station	934	21,305	145
8 Station	1,301	29,925	193
Incoterm SPD 20/40 (32K Core Memory, 10MB Disk Storage, Communications Adapter, Display [1,920 Char Screen] & 76 Key Keyboard)			
4 Station	1,496	34,570	216
8 Station	1,863	43,190	264

INFOREX INC.
System 7000 Intelligent Terminal

OVERVIEW

Inforex, Inc., a leading supplier of shared-processor data entry systems, has developed a new microprocessor-based distributed processing system, the Inforex System 7000. Featuring an interactive ANS 74 COBOL compiler, the System 7000 allows users with distributed operating facilities to perform data entry, data processing, file management, and data communications functions concurrently, at any local or remote location.

The System 7000 is available in two models: the Model 7115 stand-alone terminal and the Model 7110 master control terminal. Both the Model 7115 and 7110 are built around a 16-bit Data General Nova-1200-compatible microprocessor which provides virtual memory, paging, and overlapped I/O structures for high-speed, multitasking operations. The Model 7110 master control terminal provides data editing, file management, and data communications intelligence to support up to seven local or remote terminals, all of which incorporate CRT displays and keyboards identical to those on the control terminal. The System 7000 master control terminal includes 64K bytes of semiconductor memory (expandable up to 128K bytes) and can support four 10-megabyte disk drives, a variety of output printers with speeds ranging from 45 characters per second to 600 lines per minute, and diskette drives or tape drive systems.

In addition, the System 7000 offers users three methods of local file access: Simple Sequential, Multikeyed Indexed, and Direct Access.

Both the Model 7110 and 7115 terminals allow IBM 2780 and 3780 batch communications capabilities on dialup or leased networks at speeds up to 9,600 bits per second under binary-synchronous protocol. SDLC (Synchronous Data Link Control) Communications Protocol is planned.

According to Inforex, the System 7000 is the result of an 18-month study conducted jointly by Inforex and an independent consultant to determine the habits, preferences, and concerns of users developing distributed processing systems. It is the first distributed processing system to feature the power, performance, expandability, and flexibility of a minicomputer and the size and price of a microcomputer.

Initial deliveries of the Inforex System 7000 are scheduled for the second quarter 1977.

COMPETITIVE POSITION

The introductions of the intelligent terminal signaled the beginning of a new concept in data processing: distributed processing. This concept became more popular with each new offering of small business computers, front-end processors, shared-processor data entry systems, intelligent network processors, etc. Many of these new systems utilized minicomputers to power and control the entry, processing, and transmission of data from their system to a central processor. However, some mincomputer systems require nonstandard operating systems and special applications software.

Inforex, after conducting an in-depth study of distributed processing users, designed a true distributed processing system, the System 7000, that combines the power and performance of a minicomputer with the size and price of a microprocessor. This unique combination makes the System 7000 capable of an advanced level of multitasking operations at a local site, while relieving the central processor of the burden of managing data communications. An essential

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HEADQUARTERS

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difference between the System 7000 and most other distributed processing systems available today is its word length of 16 bits, which allows the processor to perform, in some cases, twice as efficiently as machines using only single-byte eight-bit word lengths. The System 7000 also has overlapped I/O channels that permit extremely fast movement of information to and from external storage media, at data rates up to 312 kilo bytes per second.

An instruction set of 224 instructions, plus an additional I/O addressing capability of up to 62 addresses, gives System 7000 the multitasking performance of what is normally considered a much larger computer processor.

System 7000 in its current version features multitasking, which allows more than one terminal to access the same data base simultaneously, and also concurrency, which allows different jobs — data entry, processing, report generation, or communications — to be performed from different terminals at the same time.

Together, multitasking and concurrency represent a major user benefit, since most remote terminals will be called upon to perform a number of different transaction-oriented jobs throughout each day. Other distributed processing systems currently available offer multitasking, but no other microcomputer-based system offers the full concurrency of System 7000.

Potential users of distributed processing have a number of other vendors and systems to choose from — Burroughs, IBM, Four-Phase, and Raytheon, to name a few. Burroughs offers the less expensive TC 5115 Intelligent Terminal system which features an on-board processor, matrix printer, keyboard, self-scan display, and peripheral diskette storage devices. The larger, more expensive Burroughs B-700 Series with a base configuration of a 32KB central processing unit, 4.6MB disk, and console keyboard/printer at $34,000 purchase or $875 monthly rental is an attractive alternative. IBM offers its System/32 with optional communications adapter, System/3 Model 8 configured with the IBM 3741 Data Entry Station or 3270 Information Display System, and the 3740/3790 Communications System. The latter two systems offer comparable instruction sets, cycle times, and access speeds, as well as IBM binary synchronous and SDLC communications protocol. The IBM 3790, however, ranges in price from $50,000 to $140,000 purchase and $1,420 to $3,500 monthly rental. The Raytheon PTS/1200 Distributed Procesing System and Four-Phase IV-70 Systems are comparable in performance, but more expensive than the Inforex System 7000.

When evaluating these interactive systems, the potential user must take into account the software support required for entry level processing and file maintenance, as well as the communications capability. The Inforex System 7000 offers a simple approach by utilizing an industry standard programming language (ANS 74 COBOL) and industry standard hardware to meet the current and future needs of users planning distributed processing systems.

USER REACTIONS

There is no user case history to date due to the newness of the Inforex System 7000.

SYSTEM DESIGN

The System 7000 uses a Data General Nova-1200-compatible microprocessor supplied by Beehive Medical Electronics. Both the Model 7110 master control terminal and Model 7115 stand-alone terminal feature:

- Four 16-bit accumulators.
- Instruction set of 224 instructions.
- Automatic program loading.
- Up to 62 input/output addresses.
- Memory cycle time of 800 nanoseconds.
- Direct memory access channel.
- 16 levels of high-speed interrupts.

In addition, the advanced microprocessor design provides for virtual memory, paging, and overlapped structures for high-speed multitasking operations.

The System 7000 offers three methods of memory access: Simple Sequential, Multikeyed Indexed, and Direct Access. The direct access memory channel allows the disk I/O control and microprocessor to share memory cycles with a main system processor.

Each Model 7110 master control terminal can support up to seven local and/or remote terminals, all of which incorporate CRT displays and keyboards, and four mass storage devices, as well as a variety of output printers with speeds ranging from 45 characters per second to 600 lines per minute. The Inforex System 7000 was designed specifically to include some of the best-known peripheral devices in the data processing industry:

- Model 7210 CRT Display (supplied by Beehive Medical Electronics) offers a 1,920-character display, detachable keyboard with the 128 ASCII character set, 14 special programmable keys, and optional PROMS (Programmable Read Only Memory).
- Model 1415/1416 Console Printers (Diablo Hy Type II Print Mechanism and Centronics) offer 45 and 165 character-per-second printing with parallel I/O or RS-232-C interface ports.
- Model 1407/1408 Line Printers (Data Products) offer 300 and 600 line-per-minute printing on a 132-character line.

- Model 7352 Diskette Drive (Shuggart) offers 360 revolutions-per-minute rotational speed, 31KB/per second data transfer rate, and 512 KB storage capacity.
- Model 7301 Disk Cartridge Drive offers 2,400 revolutions per minute rotational speed, 312KB/per second data transfer rate, and 10 mega/byte storage capacity.
- Model 7401/7402 Tape Drive (Digi Data) offers nine-track recording in 800/1,600 bit-per-inch density at 37 inches per second.

The hardware design of the System 7000 enhances the capability of the system software. Inforex has developed a subset of ANS 74 COBOL to incorporate several important data entry features the user will have available without special programming: Cursor Control, Field Definitions, Check Digits, Table Lookup, Range Checks, Audit Logs, Error Control, Easy Reset, and Character Insert/Delete. These features will increase the efficiency of data entry, inquiry, and validation functions performed on the System 7000.

Table 1 provides a summary of system specifications.

COMPATIBILITY

Since the Inforex System 7000 is a microprocessor-based system featuring an interactive COBOL compiler, it is hardware and software compatible with most medium- and large-scale computer systems.

COMMUNICATIONS CAPABILITIES

The Inforex System 7000 master control and stand-alone terminals feature both IBM 2780 and 3780 batch communications capabilities over dialup or leased line networks at speeds up to 9,600 bits per second under binary-synchronous protocol. In order to meet future user communications requirements, Inforex has made a commitment to implement SDLC (Synchronous Data Link Control) Communications in late 1977.

Peripheral communications compatibility is facilitated via parallel I/O or RS-232-C interface ports.

A number of sophisticated communications-oriented features are scheduled on the System 7000 to enhance system throughput and lower communications costs. Among these are:

- Interactive Communications — In addition to batch processing, through the addition of IBM 3270 emulation.
- Down-line Software Loading — Permits control of System 7000 configuration installed at distributed operating facilities to be maintained from a central location. All remote program files can be updated from a central facility within seconds, even if the remote sites are unattended.
- Auto-Dial/Auto Answer — Current versions of System 7000 feature an auto answer capability which permits a central site to gather data from unattended System 7000 installations. The feature permits a corporate headquarters to gather data late at night, when communications line charges are lowest. An auto-dial capability will permit System 7000 control terminals to poll data from unattended master or local terminals automatically.
- HASP (Houston Automated Spooling Program) multileaving — This feature allows System 7000 users to hold communications line charges to a minimum. System 7000 terminals will be able to function as HASP workstations, and system messages can be interleaved with processed data to

Table 1. Inforex System 7000 Intelligent Terminal Specifications

CONTROL PROCESSOR	
Word Size, Bit	16
Cycle Time, nsec	800
Standard Memory	64KB
Maximum Memory	128KB
I/O Channels	8
Language Supported	ANS COBOL
DATA COMMUNICATIONS	
Line Facilities	Voicegrade; leased
Line Speed (bps)	1,200 to 9,600
Line Mode	HDX; FDX
Line Code	ASCII/EBCDIC
Synchronization	Bisync
Interface	RS232C; 20 ma current loop
PERIPHERALS	
CRT Display:	
Screen Size (char)	1,920
Char per Line	80
Lines per Display	24
Paging Capacity	Yes
Char Set (char)	128 ASCII
Char Generation	5x7 dot matrix
Features	Detachable keyboard; numeric keypad
Terminal Printer:	
Method	Impact
Max Print Line (char)	80 or 132
Speed (cps)	45/165
Line Printer:	
Max Print Line (char)	132
Speed (lpm)	300/600
Diskette Drive:	
Transfer Rate (KB/sec)	31
Storage Capacity (KB)	256
Disk Cartridge Drive:	
Transfer Rate (KB/sec)	312
Storage Capacity (MB)	10
Magnetic Tape Drive:	
Density (bpi)	800/1,600
COMPATIBILITY	
Computer System	IBM Sys 360/Sys 370
Terminals Emulated	IBM 2780/3780/3270
FIRST DELIVERY	1977

improve system turnaround while lowering data transmission costs.

- Network Pass-through — Permits a stand-alone, master, or remote System 7000 terminal to access data no matter where that data is stored. Searches for data begin at the local data base level and branch automatically to other storage locations throughout the system, including the central data base.
- Terminal to Terminal Communications — Facilitates the control of cluster terminal configurations when terminals within those clusters are located at considerable distances from each other.

SOFTWARE

The System 7000 supports the transaction-based applications typical of most distributed computing operations with its ANS 74 COBOL subset. Inforex selected ANS 74 COBOL since it is the industry standard and has the advantage of widespread familiarity among programmers. Software development and maintenance is facilitated by the standard routines and parameters employed by the ANS 74 COBOL subset.

Inforex will add RPG II (Report Program Generator) to the System 7000 in late 1977 to provide the user with a simple but powerful means of preparing a variety of local reports. BASIC will be added as a third programming language early in 1978.

MAINTENANCE

Inforex maintains sales and service offices in 70 U.S. cities and 20 foreign countries.

Maintenance is included in both the 12-month and 42-month lease plans on a prime shift basis, Monday through Friday. Inforex will provide emergency maintenance service for a surcharge. A separate maintenance contract is available for users of purchased equipment.

PRICE DATA

Model No.	Description	Purchase Price $	Monthly Rental (Incl Maint.) 12-Mo. $	Monthly Rental (Incl Maint.) 42-Mo. $	Maintenance $
7110	Master Control Terminal	17,450	412	349	95
7115	Stand-alone Terminal	9,100	200	164	50
7210	CRT Local/Remote Terminal	4,000	100	80	15
1415	45-cps Printer	7,750	185	155	40
7021	45-cps Controller	1,750	41	35	7
1416	165-cps Printer	7,250	175	145	50
1407	300-lpm Line Printer	18,860	402	362	88
1408	600-lpm Line Printer	23,150	547	492	130
7020	165-cps Controller	250	6	5	1
7301	Disk Cartridge Drive	13,000	307	260	75
7321	Disk Controller	2,650	62	53	7
7351	Diskette Drive	1,500	38	30	8
7372	Diskette Controller	900	23	18	5
7401	9-Track 800 bpi Tape Drive	7,250	172	145	58
7421	9-Track 800 bpi Tape Controller	4,900	113	98	7
7402	9-Track 1,600 bpi Tape Drive	8,600	203	172	77
7422	9-Track 1,600 bpi Tape Controller	5,750	133	115	7

IBM CORP
3735 Programmable Buffered Terminal

OVERVIEW

The IBM 3735 is a programmable, buffered keyboard printer that can transmit at medium speeds to IBM System/360 and 370 computers. It consists of a Selectric II printer (15.5 characters per second) and keyboard plus a desk-side control unit. An optional 66 character-per-second printer can be attached as can the IBM 5496 Data Recorder. (The 5496 can read or punch 96-column cards.)

Under control of its own stored program, source documents can be prepared and data concurrently stored on a fixed disk buffer for subsequent transmission to the computer in a batch mode. Programmed controlled indicators guide the operator through the document preparation steps while local data processing and control functions take place. Functions such as formatting, editing, arithmetic calculations, logical comparisons, and error checking can be provided in conjunction with automatic print element positioning and forms control. Capability of this type enhances the communications efficiency in that transmitted messages need include only that data required by the computer.

Transmission can be point-to-point or, when optionally equipped, multipoint over dedicated voiceband facilities at speeds of 1,200, 2,000, 2,400, or 4,800 bits per second. (It acts as a tributary station in multipoint networks in a polling/addressing environment.) It can also communicate over the public switched network on a point-to-point basis at 1,200, 2,000, or 2,400 bits per second. IBM's Binary Synchronous Communication (BSC) technique is employed.

The 3735 is used to best advantage in business applications where batch transmission of a sizable amount of data from/to fixed formatted (preprinted) forms is required in the data processing function. It can store, for instance, an operator's full day's output for later unattended batch transmission.

Table 1 provides specifications for the 3735.

COMPATIBILITY

The 3735 is a BSC terminal that operates in the half-duplex mode. It can communicate with IBM System/360 Models 22 through 195 via the 2701 Data Adapter Unit or the 3705 Communication Controller in the emulation mode. It can communicate with System/370 Models 115 through 195 via the 2701, 2703, or 3705 (emulation or NCP modes). Communication with System/360 Model 25 and System/370 Model 135 can also be via their Integrated Communication Attachments.

The 3735 can operate with one of the following four speed/facility possibilities and with the indicated Bell System (or equivalent) modems:

(1) 1,200 bits per second — on the public switched network with Bell 202C;
(2) 1,200 bits per second — on dedicated facilities (3002-C1) with Bell 202D;
(3) 2,000 bits per second — on the public switched network or dedicated facilities (3002-C2) with Bell 201A;
(4) 2,400 bits per second — on dedicated facilities (3002-C2) with Bell 201B.

When the 3735 is used with Bell 202 (or equivalent) asynchronous modems, the Synchronous Clock is required in the 3735 and must be added as a special feature. In addition, in this situation, the device with which the 3735 is to communicate must incorporate an internal clock that operates as the same data rate.

Either EBCDIC or ASCII transmission code can be specified with the 3735. ASCII with uppercase only is supported. If the 3286 Model 3 printer attachment is included with the 3735 and if the ASCII character set is desired on this printer in lieu of the standard EBCDIC code, one of two ASCII character sets (A or B) can be chosen. The ASCII character set chosen must also be specified for the 3735 in this case.

One or a number of 3735s can be used on multipoint polled/addressed leased lines with other BSC tributary devices such as the IBM 3270, 2780, and 2770. All 3735s on the line require incorporation of the Multipoint Data Link Control special feature and all must use the same transmission code and data set attachment. Transparency is not available on the 3735 although other devices on the same multipoint line may incorporate the feature.

HEADQUARTERS

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Table 1. IBM 3735: Specifications

Manual Input	
No. Char Generated	60
Code Generated	EBCDIC; ASCII opt
Control Unit	
Memory Type	Fixed disk
Memory Size, bytes	62.8K (customer usable)
Add'l Storage, bytes	2 – 41.8K increments; 1 – 167.5K increment
Error Control	VRC on internal transfers; LRC on disk data
I/O Adapters	5496 Data Recorder opt; 3286 Model 3 Prntr opt
Printer	
Method	Impact
Platen Feed Type	Friction; pin (specify)
Carriage Width (in.)	15-1/2 (13-in. print line)
Code	EBCDIC; ASCII opt
No. Printable Char	88 (u/l case)
Max Print Line (char)	130 or 156
Speed (char/sec)	15.5
Data Transmission	
Line Facilities	Leased (3002); switched voiceband
Line Speed (bits/sec)	1,200; 2,000; 2,400; 4,800
Line Mode	Half-duplex
Line Code	EBCDIC; ASCII opt
Synchronization	Sync (BSC)
Error Control	
Generation	CRC (EBCDIC); VRC/LRC (ASCII)
Detection	Same as above
Correction	Auto retransmit via BSC
Features	
Auto Answer	Yes
Integral Modem	Opt
Portability	No
Polling/Addressing	Opt
Compatibility	
Computer System	S/360 and S/370
Terminal Standard	IBM 3735
Bell System Data Set	202C, D; 201A, B
First Delivery	May 1972

PERFORMANCE AND COMPETITIVE POSITION

The heart of the 3735 is the control unit. It houses the magnetic disk, three dynamic buffers, the arithmetic and logic unit (ALU), and the BSC adapter.

The magnetic disk, organized into sectors of 480 bytes each, stores two types of programs plus customer data. In addition, disk areas are allocated for counters, inquiry and reader/punch buffers, a data directory, and special storage. Buffers and special storage are byte addressable. Arithmetic operations (add, subtract, multiply, divide, divide with rounding) are standard provisions.

The dynamic buffers can each buffer a sector of data/programs between the disk and the terminal I/O. For instance, blocks of data from the communications line (up to 476 characters, not including control characters) are temporarily stored in a buffer, checked, and (if correctly received) transferred to the disk. Data to be transmitted, similarly limited to blocks of 476 bytes, is also stored in these buffers. Unattended transmission is standard procedure.

The 3735 is programmed to efficiently process standard business forms. It is controlled by two types of programs: user-generated Form Description Programs (FDPs), and the IBM-generated (during manufacture) Terminal Control Program (TCP). Each form type processed on the 3735 has a corresponding FDP that describes the form in terms of its pages, lines, and fields.

The location of each field of a form, for example, is identified by the FDP in terms of its line number and horizontal position on that line. Also specified, if required, are the associated source and sink for the field (normally keyboard and printer, respectively) as well as any arithmetic, compare, and edit operations required on the field's data. (Other commonly used functions, such as comma and decimal insertion, are performed via the TCP.) An indication is also given if the data is to be stored for later transmission to the CPU and in what format the data is to be transmitted. Three field formats are possible: blanks for unused character positions, a delimiter after the last character, or no blanks or delimiter.

The single TCP serves to interpret the FDPs and executes the operations specified by them to control the terminal. Typically, thousands of TCP instructions will be executed for each FDP. TCP subroutines can also be selected from the terminal keyboard. IBM states that an FDP usually requires about 1K bytes of storage. This corresponds roughly to four sectors since only 234 bytes of a sector are used for FDPs.

There are five modes of operation of the 3735: Local, Enter-Form, Error-Correct, Playback, and Request. In the local mode, the 3735 operates without program control like a standard office typewriter. Selection of the desired FDP and other operating modes is from this mode.

Normal program-controlled form processing occurs in the Enter-Form mode. Error correction in this mode is limited to backspacing and retyping within the field being processed. Correction of errors in preceding fields on the same line (not preceding lines) can be accomplished by entering the Error-Correct mode.

The Playback mode permits correction of updating on lines preceding the line being processed by calling up previously processed information.

Once in the Request mode a second function is keyed in that permits auxiliary operations including the following: communicate mode (operator or CPU actuated), erasure of operator/CPU-created data, FDP and

data record listing, and selection of diagnostic on-line tests.

FDPs are assembled via System/360 and 370 OS and DOS Assembler Language macroinstructions. A Form Description Utility (FDU) prepares the FDPs for transmission from the CPU to the 3735. FDPs must be loaded in this manner (from the CPU) and must remain resident on the 3735 disk until replaced by the CPU. BSC support for the 3735 is OS/BTAM and TCAM and DOS/BTAM.

The 3735 competes with terminals from Burroughs, Victor, NCR and others. While flexible in terms of accommodation of different types of forms via different FDPs, it does not provide the capability to simultaneously process multiple forms (on an independent basis) as do many of its competitors. Also, its off-line use is limited. Programs cannot be loaded off-line nor can it function as an accounting machine off-line. This reflects IBM's philosophy of keeping the intelligent terminals intelligence CPU dependent.

CONFIGURATION GUIDE

The basic 3735 configuration consists of a Selectric II keyboard, a Selectric II printer, and the control unit. Optional attachments allow the connection of the IBM 3286 Model 3 printer and the IBM 5496 Data Recorder. Provisions to attach the 3286 Model 3 and the 5496 can be made in the field, if required.

The Selectric II keyboard has the set of keys found on the standard office Selectric typewriter but includes a group of 10 numeric keys arranged in adding machine format. The typewriter keys are flanked on both sides by operating control keys and operator guidance lights. A 13-foot keyboard-to-control unit cable is standard equipment.

The Selectric II printer includes the standard friction-feed platen that can accommodate 15-inch forms. Horizontal spacing is 10 characters per inch; vertical spacing is six lines per inch. A fully interchangeable pin-feed platen can be specified as an alternative. This platen accommodates forms with hole-to-hole widths from 5-1/4 to 13-1/8 inches. Also available is an optional forms stacker for continuous forms placement before and stacking after printing.

The desk-side control unit contains a nonremovable disk with 62.8K bytes of storage. Additional user storage is available in two increments of 41.8K bytes each and a third increment of 167.5K bytes for a total of 314.1K bytes. A binary synchronous communications adapter for transmission rates to 4,800 bps is standard. A 15-foot control unit-to-data set cable is also provided as standard equipment.

MAINTENANCE

IBM's worldwide network of customer engineers provides maintenance for 3735 equipment. The standard contract provides for on-call service during any prespecified 8-hour period from 7:00 a.m. to 6:00 p.m. Emergency service is available on a 24-hour basis at higher rates. Basic service is included in lease plans; separate contracts must be negotiated by users of purchased equipment. Except for charges that are subject to change on three months' written notice, IBM will give one year's written notice prior to modifying the maintenance contract.

PRICE DATA

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
	Basic Configurations			
3735-001	Programmable Buffered Terminal	369	11,390	78
	Configuration Options			
1450	Buffer Expansion	28	867	2.50
	Mass Storage			
1001	Additional Storage (1st increment; 42K)	33	1,035	.50
1002	Additional Storage (2nd increment; 42K)	33	1,035	.50
1003	Additional Storage (3rd increment; 168K)	77	2,425	2.50
	File Storage Capacity	12	480	1
	Peripherals			
3950	5496 Attachment for Data Recorder	28	867	.50
4600	Operator Identification Card Reader	16	520	3.50
4695	Keylock	35 SUC	35	NC
5010	Multipoint Data Link Controller	16	520	.50
5500	1,200-bps Integrated Modem	16	535	3
5501	1,200-bps Integrated Modem (switched with auto answer)	21	714	3.50
5600	2,400-bps Integrated Modem			
	Point-to-Point	70	1,905	12
	Multipoint	77	2,115	14
	Switched	78	2,170	14
7705	Sync Clock	16	520	.50
7880	3286 Printer, Model 3 Attachment	16	520	.50
7951	Switched Network Back-up	10	303	3.50

Note:
Rent price applies to 30-day charges (MAC) and is approximately 8% higher than 1-year lease.
SUC — Single Unit Charge.
NC — No charge.

IBM CORP
3790 Communications System

OVERVIEW

The 3790 Communications System is a highly flexible unit which is equally at home functioning as a powerful component in a distributed processing network, or as a standard programmable workstation. (See Figure 1 for configurations.) The basic components of the 3790 consist of a 3791 Controller plus a cluster of operating stations comprised of Model 3277 Display Stations, 3793 Selectric Keyboard-Printers, and 3284, 3286, or 3288 Printers. The basic 3791 can accommodate up to 31 Model 3277s and/or 3284/3286/3288s in any combination. Specifications for the 3790 are provided in Table 1.

The heart of the 3790 is its 3791 controller — a minicomputer with 8K to 196K bytes of main storage. The 3791 handles up to 31 independent jobs. Auxiliary storage is provided by a disk with a 10-megabyte capacity, although that capacity can be field upgraded to 20 or 30 megabytes. IBM also offers magnetic tape support. Users may attach a 3411 Magnetic Tape and Control Unit Model 1; up to three 3410 Magnetic Tape Units Model 1 can be attached to the 3411 controller.

The communications capabilities of the 3790 include interactive and batch interfaces which operate with CICS/VS and IMS/VS. With these facilities, users may add, delete, or modify records stored in a System/370 host mainframe. The 3790 can also take advantage of the message switching capabilities of CICS/VS and IMS/VS to interface with other terminals in the network.

A notable scheduled addition (first quarter 1978) to the 3790's communications capability is a Remote Data Link Adapter which permits 1,920-character display versions of the 3276 terminal/controller to be attached to the 3791 by communications lines. In the past, terminals could only be attached locally. A single 3791 can handle up to five Remote Data Link Adapters. Each Adapter can support up to five 3276s, each with up to seven 3278s.

At present, local program development is not possible with the 3790. (All program development must be done in the host and then down-loaded.) In first quarter 1978, IBM will release a new programming product called Display Management System/3790. This new feature will permit program statements to be entered through the 3790 for host processing.

DMS/3790 provides a forms-oriented program generator which produces programs called screen handlers. The user defines the screen handler on a set of forms which he uses to describe layouts, input and output fields, and field editing characteristics. Actual program compilation, however, is still handled by the host.

For those wishing to prepare these forms interactively, an Interactive Screen Handler Generator is available for use with CICS/VS, TSO or VM/370. The 3277 Model 2 will be supported under this facility.

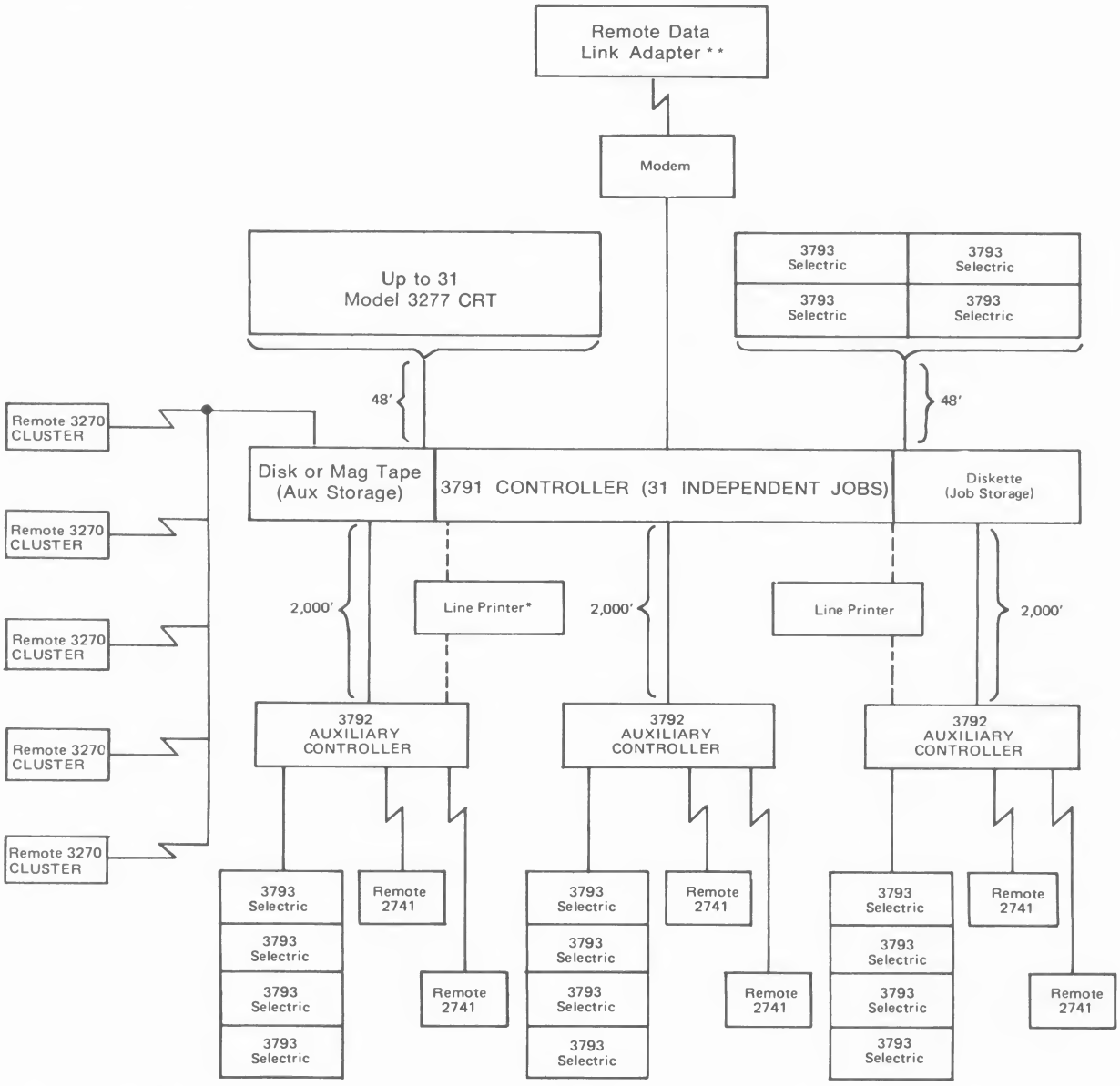
Additional programming support — projected for the third quarter of 1978 — will permit both interactive processing and RJE. This programming enhancement and RJE support are operative with the 3774 and 3775 under SNA. RJE support allows jobs to be submitted to the host under Power, RES, JES 2, and JES 3. Job output can be routed to the terminal's printer, card punch, or diskette.

Normal communications control between the 3790 and the host employs SDLC protocol. The 3790 transmits to a 3704 or 3705 front-end controller. Terminal access methods include VTAM, TCAM, or TCAM through VTAM. Transmission is full-duplex at rates of 1,200 to 9,600 baud. Transmission at 1,200 baud is clocked through the SDLC Adapter; transmissions up to 2,400 or 9,600 baud use the EIA Standard RS-232-C interface and are unclocked.

PERFORMANCE AND COMPETITIVE POSITION

IBM purportedly has developed the 3790 in response to an in-house study of the insurance industry, which stated that IBM's annual growth objective of 10 to 12 percent could not be met by concentrating on volume-dependent applications alone. The resulting 3790 system provides a way for users to cut paper and clerical costs as well as to improve the speed and accuracy of data entry. Because the inquiry/response, data entry, calculation, and document preparation involved are general-purpose applications, the 3790 will undoubtedly become an attractive system for other types of businesses that are smothering in blizzards of paperwork.

The 3790 is an important system in many respects. The use of SDLC line discipline, with the implied improvement in communications, sets a new standard for transmission accuracy at higher speeds. The use of SDLC as its protocol enables the 3790 to conform to IBM's network architecture, Systems Network Architecture (SNA).



*One Line Printer can be connected to 3791 and one to a 3792, or both can be connected to 3792s. When attached to a 3792, the line printer takes the place of 2 other devices.

**Up to five remote Data Link Adapters, each supporting up to five 3276's. Each 3276 can handle seven 3270's.

78—33

Figure 1. IBM 3790 System: Maximum Configuration

Table 1. IBM 3790 System: Specifications

Microprocessor	
Main Memory (bytes)	8K-196K, plus 8K/auxiliary controller
Word Length (bits)	8 bits
Program Languages	Not released
Auxiliary Controllers	1-3
Max Devices/System	13 on main controller; 6/auxiliary controller; 31 total
Auxiliary Storage	
Storage Medium	Disk or magnetic tape
Capacity (bytes)	10M, 20M, or 30M on disk
Transfer Rate (cps)	Not released
Data Entry	
Hard-Copy & Key-Data Entry	3793 keyboard-printer (Selectric typewriter, 15.5 cps printer)
Key-to-Disk	3760/3762 key entry station (keypunch keyboard, 236-char display screen)
Code Generated	EBCDIC (ASCII opt)
CRT Display	
Max Char/Line	80
Max No. of Lines	12 or 24
Page Printers	
Max Char/Line	NA
Rated Speed (cps)	15.5
Peripherals	
Card I/O	No
Paper Tape I/O	No
Diskette	Yes, 1
Line Printer	120 lpm (1 or 2)
Mag Tape I/O	Yes, one 3411 and three 3410s
Others	Remote 2741s (up to 6) & remote 3270 clusters (up to 5)
Line Transmission	
Line Facility	Switched/nonswitched; duplex-/half-duplex; point-to-point/multi-drop
Transmission Code	Transparent
Data Rate (bps)	1,200-9,600
Synchronization	SDLC
Interface	EIA and SDLC
Compatibility	
Computer System	IBM 370 VS models
Terminal Emulation	None
Modem	Internal or external

Notes:
NA Not Available

Because it is more of a general-purpose system than are IBM's 3600 Financial, 3650 Retail, and 3660 Supermarket Intelligent Systems using SDLC, the 3790 will compete directly in the distributed processing market with the products of several independent intelligent terminal manufacturers.

SDLC

IBM's SDLC line discipline allows half- and full-duplex transmission, a feature that will enhance performance in multi-point and loop facilities as well as in point-to-point operation. Moreover, SDLC is bit-oriented rather than character-oriented, significantly reducing the number of overhead control characters required for each transmission. In general, it is more effective in interactive environments, provides more complete checking facilities, and allows greater control and responsiveness than the half-duplex, character-oriented Binary Synchronous Communications (BSC) method. In short, it provides a great many improvements over previous protocols.

The general assembly of the European Computer Manufacturers' Association (ECMA) and the International Standards Organization (ISO) have adopted a bit-oriented protocol based on SDLC. The protocol, High-Level Data Link Control (HDLC), primarily varies from SDLC in the format for control bits and in the related control procedures. The American National Standards Institute (ANSI) is preparing to adopt a substantially identical version of HDLC as its standard bit-oriented protocol. The ANSI version is called Advanced Data Communications Control Procedure (ADCCP). Whether IBM intends to provide support for HDLC/ADCCP is an open question at the moment.

In any event, the change in protocol will present some problems for independent manufacturers trying to market replacements for IBM terminals. Manufacturers of intelligent terminal systems may find that a new program can convert existing systems, but manufacturers of "dumb" terminals will have to redesign the hardware interfaces.

Distributed Processing

A number of mainframe and independent manufacturers have developed intelligent terminal systems for distributed processing networks; these systems are gradually reducing the paperwork and clerical problems of large organizations and increasing the accuracy of data entry. Burroughs, NCR, and Honeywell terminals, all nonclustered systems, have tended to be associated with their manufacturers' own mainframes. Independent manufacturers, on the other hand, were oriented toward IBM compatibility from the first — through emulation of IBM terminals and through production of IBM-compatible computer tapes, which can be used with a 360 or 370 mainframe. Four-Phase IV/40 and IV/70, Datapoint 2200, Sanders 800 Series, Raytheon PTS/1200 System, and the MDS 2400 systems are most nearly comparable to the IBM 3790 system. All these systems provide a wide range of processing power, use associated auxiliary disk storage, and can attach terminal clusters to a single center processor for time sharing.

In general, the independents' systems have smaller maximum memory and disk sizes but support larger workstation clusters. All except MDS stress distributed processing; MDS markets the MDS 2400 as a "peripheral processing system," stressing communications functions. Users, however, have done quite a bit of local distributed processing on the MDS 2400. In addition to

assembly language, all the independents' systems support higher-level languages — COBOL for Four-Phase, FORTRAN for Sanders, MACROL (Compiler) for Raytheon, and RPG II for MDS.

The cost of the 3791 Controller tends to make multiple entry stations more economical; IBM is apparently aiming the 3790 toward larger applications, leaving other terminals (such as the 3735) to compete with the stand-alone intelligent terminal systems, such as those manufactured by Sycor, Singer, and Qantel.

When the 3760 Key Entry Stations and 3762 Payment Transaction Processors are used with the 3791 Controller, the 3790 is a powerful contender in the key/disk (keypunch replacement) market, where other clustered terminal systems have found a home.

CONFIGURATION GUIDE

The central control unit for the 3790 system is the 3791 Controller, a microprogrammed CPU. The minimum 3790 configuration includes a 3791 Controller with a 10-million byte disk; diskette; 8,192 bytes of control storage; modem; and an entry station, which can be a 3793 Keyboard Printer or a 3277 Display. In the basic configuration, the Controller can handle up to 31 3277 CRT workstations, four 3793 Selectric Keyboard/Printers, and a line printer.

To expand the basic configuration or to receive data from remote 2741 sub-terminals, a 3792 Auxiliary Controller must be attached. Each 3792 can attach four more 3793 Selectric Keyboard/Printers, two lines to remote 2741 terminals, and possibly another line printer. From one to three 3792 Auxiliary Controllers can be attached to a 3791 Controller.

Further expansion is possible by using Configuration Support 9169 which allows up to five Data Link Adapters (DLAs). These DLAs will support 3270-type cluster terminal configurations via modems and common-carrier communications lines. The 3276 Control Unit Display Station Model 12 is a combination control unit and alphanumeric display unit with a 1,920-character display. The 3276 provides support functions for up to seven additional 1,920-character display stations (3278 Model 2) and/or 3287 Printer Models 1 and 2. The 3276 Model 12 is attached remotely to the 3791 via the DLA using SNA/SDLC protocol. Up to five 3276 Model 12s can be attached to each DLA; however, system performance requirements and common carrier restrictions limit the maximum number of multidropped stations. The 3287 printers can be attached to the 3791 directly as well as via the 3276. Model 1 prints a maximum of 80 characters per second, while Model 2 prints a maximum of 120 characters per second.

The actual total capacity of the system depends on the system software and its ability to handle the various I/O devices. The 3791 has two basic models, one of which has submodels. The several models and submodels are characterized by disk size: Model 1C has 10 million bytes of disk storage, while Models 2A and 2B have 20 and 30 million bytes respectively. Models 1C and 2A are field-upgradable. Earlier models, that have since been discontinued, are Models 1A and 1B with 4.8 and 8.9 million bytes of storage respectively.

Figure 1 illustrates the maximum 3790 configuration. The 3791 communicates with a host System/370 via an integrated modem (1,200 bits per second), which can be switched or nonswitched. Alternatively, a communications feature (with or without clock) allows one IBM or other external modem (9,600 bits per second) to be connected using an RS-232-C interface.

The host System/370 virtual storage CPU must include a minimum of 192K bytes of memory for DOS/VS, 320K bytes for OS/VS1, and 1,024K bytes for OS/VS2. Additional storage, based on the application, may be required. In addition to the VSAM and VTAM access methods, the host system must include the IBM 3790 Macro Library for the System/370 Assembler, Subsystem Support Services (SSS) to control the host libraries and to transmit programs from the host to the 3790, and Program Validation Services (PVS) to test and format the 3790's programs in the host computer. The 3704/3705 must include the Network Control Program to handle line protocol together with access method for the host.

In addition to the basic components, various separately-priced attachments and adapters must be added to the system to interconnect components.

3791 Controller and Storage

The 3791 Model 1C is a microprogrammed, byte-oriented minicomputer with a main storage capacity which ranges from 8K to 196K bytes. Memory modules must be added in 8K increments. Auxiliary storage is in the form of disk/diskettes and magnetic tape. The 3791 can handle up to 31 independent jobs..

The 3791 Controller Model 1C is a relatively new unit which replaces the discontinued Models 1A and 1B. Model 1C has a standard 10 megabytes of disk storage and is field upgradable to the larger Models 2A and 2B with 20 and 30 megabytes of disk storage, respectively.

Magnetic tape storage (feature 7840) is offered; users may attach a 3411 Magnetic Tape and Control Unit Model 1, plus up to three 3410 Magnetic Tape Units, Model 1.

3793 Selectric Keyboard/Printer

The 3793 can be attached to 3791 and 3792 Controllers through appropriate adapters. The 3791 Model

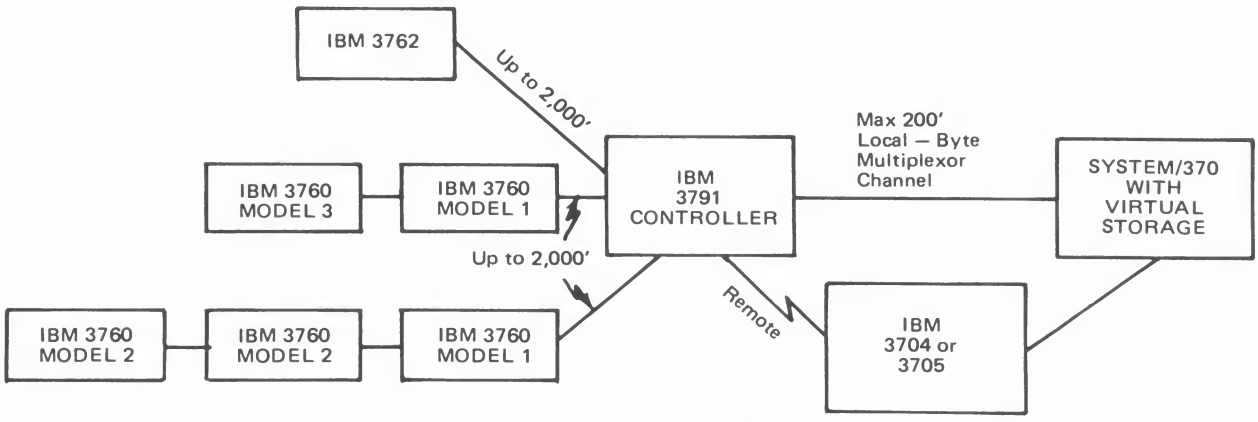


Figure 2. IBM 3790 System: Data Entry Configuration

78—34

1 Controller (4.8- or 8.9-million-byte disk) uses the 3793 keyboard; one 7902 Attachment must be added for the second 3793 and one 7903 Attachment for the third and fourth. The 3791 Model 2 Controller (18.2- or 27.5-million-byte disk) and the 3792 Auxiliary Controller both require the 7901 attachment to connect the keyboards to the appropriate controller.

The 3793 is a modified Selectric II typewriter with operator guidance lights and switches added to an EBCDIC keyboard. The standard platen is friction-fed, but a pin-fed platen can be supplied. A standard Courier 72 print element handles upper- and lowercase characters at a rate of 15.5 characters per second. Vertical form movement and print element positioning are determined by the 3791 Controller.

A 5560 Power Line Keylock provides a key-operated switch in the power cord.

3277 Display

There are two alphanumeric display models of the 3277; one displays 960 characters (80 characters per line in 12 lines), the other 1920 characters (80 characters per line in 24 lines). The display is the same display used in the 3270 terminal system; it includes either a Model 4630 keyboard (66 keys) or a Model 4633 keyboard (78 keys), an audible alarm, the 6340 Security Keylock, and the 4600 Operator Identification Badge Reader. Up to 31 Model 3277s can be attached to the 3791.

Modems

The 3791 Controller communicates with the host computer through one of the following three modem configurations:

- 5500 Nonswitched Integrated Modem (1,200 bits per second) plus the 6301 SDLC Communications Feature with Business Machine Clock. This combination provides an integrated modem with an answering capability for host communication over nonswitched lines.
- 5501 Switched Integrated Modem (1,200 bits per second) plus the 6301 SDLC Communications Feature with Business Machine Clock. This combination provides an integrated modem with an answering capability for host communication over switched lines. The coupler determines whether answering is automatic or manual.
- 3701 EIA Interface with 6301 or 6302 SDLC Communications Feature (with or without Business Machine Clock, respectively) plus an external modem.

Note that only one of the three types of modems can be attached to each 3790 system, but all three types can be field installed.

3792 Auxiliary Controller

The 3792 buffers, controls, and checks input and output data for a subcluster of up to four 3793 Keyboard/Printers and up to two 2741 terminals. Up to three 3792s can be connected to the 3791 through a single 7900 attachment. The 7900 and 3792 as well as their appendages can all be field installed.

The 6350 Security Keylock feature on the 3792 allows the system power to be turned on only when the key is in the proper position. Removal of the key does not turn power off.

The 3792 Auxiliary Controller requires a 1021 Adapter to connect two 1081 asynchronous communication controls. Each 1081, in turn, can connect either

a 3701 EIA Interface for an external modem or a 5400 Leased Line Adapter to communicate with a 2741 terminal. The 5400 provides for point-to-point communication over nonswitched lines.

Line Printers

The 4710, an 80-character print position Line Printer, and the 4711, a 132-character print position Printer, are available for attachment to the 3791. Both printers can operate at 155 lpm with a 48-character set, at 120 lpm with a 64-character set, or at 80 lpm with a 96-character set.

Also available for the 3791 is a 132-character print position Printer operating at 410 lpm with a 48-character set, 300 lpm with a 64-character set, or 230 lpm with a 96-character set.

The 4712 Printer, with an 80-character set, and the 4713 Printer, with a 132-character set, can be attached to the 3792. Both printers operate at 155, 120, or 80 lpm using 48-, 64-, or 96-character sets, respectively.

Printers attached to the 3791 must have the same number of print positions as any printer attached to a 3792. Up to two printers can be attached to a 3790 system. One printer can be attached to the 3791 and one to the 3792; alternatively, both printers can be connected to 3792s.

A 4450 Forms Stand option facilitates feeding and stacking of continuous forms.

3790 Data Entry Configuration Guide

The 3790 Communications System Data Entry Configuration consists of 3760 Key Entry Stations and 3762 Payment Transaction Processors attached to a 3791 Controller. The 3760 Key Entry Station is available in three models:

- Model 1 contains logic and storage to perform control and display functions, data editing, and checking. It has two operator keyboards and display screens.
- Model 2 is a slave unit (also with two operator keyboards and display screens) that must be connected to a Model 1. Up to two Model 2 units can be connected to a single Model 1 unit.
- Model 3 is identical to Model 1, with only one operator keyboard and display screen combination included.

A modified version of the 3760 is the 3762 Payment Transaction Processor; it resembles the 3760 Model 1 but has some additional features such as optical scanning of payment stubs, automatic comparison of the keyed check amount to the scanned amount, automatic inscribing and endorsing of checks, journal tape printing for each transaction, and automatic deposit slip creation. Up to eight 3760 Model 1s or 3s can be attached to a 3791 Controller; up to two 3760 Model 2s can be attached to each 3760 Model 1.

If only Models 1 and 2 are used (each with two operator positions), support is provided for a maximum of 12 stations (24 operator positions). For each 3760 Model 3 that is used, the maximum number of operator positions is reduced by one. See Figure 2 for a diagram of the 3790 Data Entry Configuration.

The 3790 Communications System Data Entry Configuration provides the following capabilities: editing and checking; the ability to balance at record, interrecord, and batch level under format control; counters; data entry under control of free format or user-defined format; verify; mark record; manual scan mode; automatic scan mode; and search on content. Up to nine 3760 Dual Key Entry Stations can operate concurrently while data is being transferred from the 3791 to the host. If a line printer is used with the 3790 Data Entry Configuration, however, no 3760s can be active during printing. Also, the line printer can be used only when data transmission is not taking place between the 3791 and the host.

Either 3.9 or 7.8 million bytes of disk storage are available for the 3760 Data Entry Configuration.

COMPATIBILITY AND COMMUNICATIONS

IBM 3790 communicates with a 3704 or 3705 front-end for attachment to any IBM System/370 Virtual Storage Processor. It does not communicate with System/360 because 370X front-ends operate in emulation mode with System/360, whereas the 3790 SDLC protocol demands that the 370X operate under the Network Control Program/Virtual Storage (NCP/VS) mode. NCP/VS mode is used only with virtual storage systems and the VTAM access method.

The following operating systems are available for the 3790:

- DOS/VS-VTAM
- OS/VS1-VTAM
- OS/VS2-VTAM
- IMS/VS operating under OS/VS1-VTAM
- IMS/VS operating under OS/VS2-VTAM
- CICS/VS operating under DOS/VS-VTAM
- CICS/VS operating under OS/VS1-VTAM
- CICS/VS operating under OS/VS2-VTAM

For the 3790 Data Entry Configuration, DOS/VS-VTAM and OS/VS1 and OS/VS2-VTAM are available for local channel attachment as well as remote attachment.

SOFTWARE

Applications programming for the 3790 can be done on the host computer using assembly language with the

special macro statements defined in the IBM-supplied macro library. The optional DMS/3790 allows programs to be entered at the remote site.

Control firmware supports byte-by-byte and field-by-field editing, format- and function-oriented processing, and other data entry techniques. Operators can share both 3790 programs and data sets. File options minimize the need for file reorganization.

PRICE DATA

Description	Monthly Rental (1 Yr) $	Monthly Lease (2 Yr) (ETP) $	Purchase Price (Maint not Incl) $	Monthly Maint $
3791 Controller				
Model 1C (10M-byte disk)	640	545	22,100	204
Model 2A (20M-byte disk)	911	775	31,400	194
Model 2B (30M-byte disk)	1,181	1,005	40,700	248
1590 Control Storage Expansion	31	26	1,055	6
1602 Type I Control Storage Increment	47	40	980	5
1612 Type II Control Storage Increment	47	40	980	5
Keyboard/Printer				
7901 Attachment (1 3793 on 1A or 1B or 4 on 2A or 2B)	36	31	1,300	3
7902 2nd Attachment (for 2nd 3793 on 1A or 1B)	36	31	1,300	3
7903 Additional Attachment (for 3rd and 4th 3793 on 1A or 1B)	36	31	1,300	3
3793 Keyboard Printer	119	101	3,450	28
Keyboard Display				
7911 Attachment for 1 to 4 3277s	38	32	1,300	5
7912 Additional Attachment for 5–8 3277s	32	27	1,100	3
3277 Keyboard/ Display	103	88	3,200	20
Communications				
3701 EIA Interface	12	10	400	4
5500 Nonswitched Integrated Modem	19	16	630	5
5501 Switched Integrated Modem	25	21	860	7
6301 SDLC with Clock	19	16	670	3
6302 SDLC without Clock	12	10	450	3

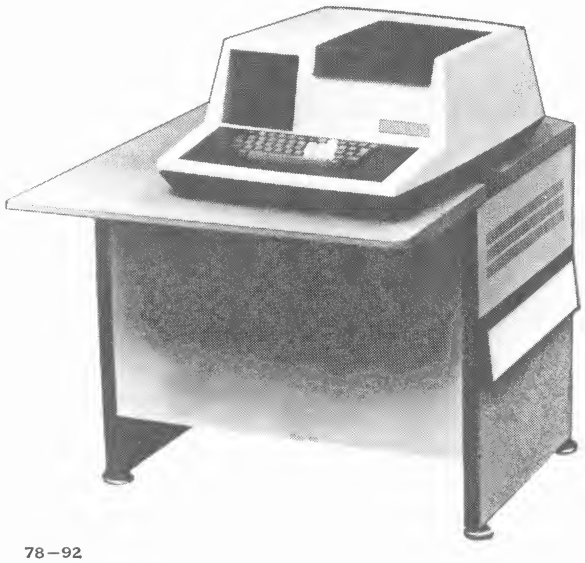
PRICE DATA (Cont.)

Description	Monthly Rental (1 Yr) $	Monthly Lease (2 Yr) (ETP) $	Purchase Price (Maint. not Incl) $	Monthly Maint. $
6350 Security Keylock	35	SUC	35	NC
Remote Data Link Adapter	30	35	1,200	—
3284 Model 1 Printer	141	120	4,255	41
Model 2 Printer	150	128	4,775	41
Model 3 Printer	122	104	4,070	22
3286 Model 1 Printer	169	144	5,690	43
Model 2 Printer	179	152	6,305	43
Model 3 Printer	155	132	5,475	42
3288 Model 2 Printer	384	327	10,625	87
Line Printer				
4710 or 4712 Printer (80 positions, 80–155 lpm)	177	151	6,175	56
4711 or 4713 Printer (132 positions, 80–155 lpm)	199	169	6,825	60
4715 Printer (132 positions, 230–410 lpm)	351	299	11,960	114
3792 Aux Control Unit (see above for 3793, 4712, 4713, 3701, 6350)	200	170	6,900	35
1021 Adapter Base	49	42	1,700	1
1081 Async	19	16	650	3
Communications Control				
5400 IBM Leased Line Adapter	19	16	650	5
1622 Control Storage Increment for 3792	59	50	2,400	5
7901 Attachment for 1 to 3 3792s	36	31	1,300	3
3760 Key Entry Station				
Model 1	259	220	9,240	45
Model 2	141	120	5,040	32
Model 3	188	160	6,770	44
3762 Payment Transaction Processor	1,410	1,220	50,400	220
Mag Tape Unit				
3410 Model 1	206	173	7,065	62
Model 2	274	230	9,450	68
Model 3	342	287	11,700	75
Mag Tape Unit & Control				
3411 Model 1	454	381	15,570	95
Model 2	578	486	19,710	102
Model 3	701	589	24,030	109
Software				
DMS/3790	300	—	—	—
CIM	200	—	—	—

Notes:
— Prices not yet released
NC No Charge
SUC Single Use Charge

ICL INC

1500 Intelligent Terminal Systems



78-92

OVERVIEW

The basic ICL 1500 Intelligent Terminal Systems, previously marketed by Singer Business Machines, are programmable, single-station, key-to-cartridge or key-to-disk data entry systems compatible with a wide variety of other manufacturers' host computers, in addition to ICL's own mainframes.

The 1500 is now available in four models ranging from the 1501 Single-Station Data Entry System, with a minitape cartridge capacity of up to 720K bytes, to the 1503 Single-Station Key-to-Disk Data Entry System capable of controlling up to 12 other 1500 terminals. The 1503 supports up to 20M bytes of disk storage on four disk drives. Other models are the 1501-40, similar to the 1501 except for its disk storage capability, and the 1502, a disk version of the 1501 with a larger screen capacity. All models have a main memory of up to 16K bytes and can support a maximum of 64 peripheral devices including printers and magnetic tape units.

The 1500 models operate synchronously or asynchronously in a half-duplex mode at speeds from 75 to 9600 bps. In addition to controlling up to four 256-character key display stations directly, the 1503 can act as a concentrator for up to 12 other 1500 systems, each with its own terminal processors. The satellite 1500 terminals can all access the 1503's disk storage directly, both to store entered data and to retrieve it selectively for key verification, validation, editing, and sorting.

ICL provides the user with packaged software to control the system functions. Basic software systems include general data entry, advanced data entry, and complex forms data entry-editor. Communications programs allow the 1500 to communicate with other data processing equipment over telephone lines. An assembler language and the assembler are provided to support all 1500 terminals. Also provided is the Business Transaction Language (BTL) System that allows the user to create programs on Models 1502 and 1503 while using the BTL programming language in cluster environments. See Table 1 for major differences among the ICL 1500 terminals.

The Cogar Corporation was the company that originally introduced the 1500 in 1971. The device was then called the Cogar System 4 and was marketed to end users by independent organizations. Singer Business Machines acquired Cogar in 1973 and began marketing the system directly to end users, renaming the unit the 1500. In late 1976, the British mainframe manufacturer, ICL Ltd, merged Singer Business Machines International Division with its own Sales Division and marketed the terminal as the ICL 1500 only outside the U.S. Since that time, ICL Inc., the U.S. Division, has been marketing the 1500 in this country. ICL markets a wide range of products including the 1900 and 2900 series of computers, the 7500 terminal processors, and various peripherals. To date, over 7,500 ICL 1500 terminals have been delivered in the U.S. and abroad.

PERFORMANCE AND COMPETITIVE POSITION

The 1500 joins a number of cassette-based intelligent display terminals that have become increasingly popular in today's market. Many of these are essentially similar in functional characteristics. They are basic minicomputer-controlled keyboard/display systems that use tape cassettes for auxiliary data and program storage, and

HEADQUARTERS

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197 Highway 18
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Table 1. ICL 1500 Models: Configurations

	1501	1501-40	1502	1503
Processor				
Main Memory (bytes)	8K - 16K	16K	8K - 16K	16K
Addressable Registers	14 - 56, stack accum	56, stack accum	28 - 56, stack accum	56, stack accum
No. of Satellite 1500 Processors	—	—	—	1 - 12 opt
Auxiliary Storage				
Mini-tape Cartridge	Yes, up to 600-128 char records	Yes, up to 600-128 char records	Yes, up to 600-128 char records	Yes, up to 600-128 char records
Fixed-disk	No	Yes, 2.5MB	No	Yes, 20MB (4 drives)
Per System	240K - 720K	2.5M	240K - 720K	2.5M - 20M
Avg Random Access (ms)	—	70	—	70/40
Transfer Rate (bytes/sec)	200	195K	200	195K
Keyboard Entry	1 std	1 std	1 std	1 std
Console Layout	Kypch	Kypch	Kypch or Tw	Kypch or TW
Numeric Pad	Opt	Opt	Std	Std/opt
CRT Display				
Max Char/Line	32	32	80	80, 32
Max No. of Lines	8	8	24	24, 8

allow for attachment of a variety of peripherals. As with the 1500, communications is frequently optional, so that the system can be used as a freestanding data entry device with either cassette or computer-compatible tape output. Data recorded and key verified on the 1500 can be transmitted to the host mainframe on industry-compatible magnetic tape or over a communications line.

Two determining factors in this market, given the basic similarity of configurations and competitive pricing, are the degree of software development and the marketing strength of the manufacturer. ICL competes with Sycor, Datapoint, Harris, and Incoterm. These systems are all marketed by relatively smaller manufacturers that have won a strong position in the market by virtue of entering it early when the interest in intelligent terminals was just beginning to expand. Consequently, the early entrants have had the time to develop quality software support and establish a considerable user base.

There is only a very limited overlap between the ICL 1500 and other ICL products. The ICL 7502/15 Standalone/Interactive Terminal System announced in February 1976 also has off-line key-to-diskette data entry capability. But there the similarities end.

The 7502/15 can alternate between off-line data entry and interactive file inquiry on the host computer system, which 1500 series systems cannot do. The 1500 series systems can interface to a wide variety of host computer systems, whereas 7502/15 systems can only interface to ICL host computers. From a cost standpoint, the 7502/15 cluster systems are more expensive in small configurations than the single-station 1500 series systems.

USER REACTIONS

One user, a major manufacturer and distributor, has had one 1501 and one 1503 for over three years. Both terminals are used as RJE devices — one for time sharing, the other for batch transmission. A spokesman for the company said that one terminal services an IBM 370 and the other services a Honeywell 620 computer. He noted that the terminals have been quite useful in the firm's applications. What he liked least about the units was their display capacity (256 characters), which he described as somewhat small for his needs. Maintenance support has been fair to date according to the spokesman.

A shipping company has used about a dozen 1501s for over three years. One terminal is now stationed in New York to receive data; three terminals are in San Francisco; and four each are in Australia and New Zealand, to carry out data entry functions, report generation, and other applications. The user in New York stated that the terminals have been very dependable. In the past year, no maintenance work has been needed on the units and he has experienced no downtime in two years, although the New York terminal is used on a limited basis.

A third user, a computerized billing service in the Midwest, uses a 1500 terminal to receive billing information from customers. This data is put on a tape drive for eventual transmission to the company's in-house computer. The information from the computer is then printed and sent to customers. What the spokesman liked best about the terminal was that it handled transmission and polled information to the tapes very well. He said that maintenance support has been very good and that there have been no major operational problems, considering the terminal's high usage. He also noted that the unit was easy for him to learn to operate. to operate.

CONFIGURATION GUIDE

The basic 1500 system consists of a processor with 8K to 16K bytes of memory, a CRT display, dual car-

tridge tape drives, a keyboard, a serial I/O interface, and interfaces for both a numeric keypad and an external dual magnetic tape. A built-in parallel I/O interface is not installed unless one of the options that requires it is ordered. In that case, its cost is normally included in the price of the option.

A single cable, up to 1,500 feet, from the built-in serial I/O interface can connect the 1500 terminals to a maximum of 63 peripheral devices and communications lines. The 1535 Synchronous or the 1534 Asynchronous Communications Adapter is required to attach a communications line to the I/O interface.

Up to three Model 1533 dual minitape cartridge drives can be furnished as standalone peripherals. They attach in series to the dual-drive interface that is built into the 1500 system. The Model 1530 numeric keypad can also attach to a special interface built for it in the 1500 workstation.

If rapid access to local files is desired, a 1500 disk-version (the 1501-40) is available. This terminal has a 16K-byte processor and a fixed disk with 2.5M bytes of storage. The 1501-40 is similar in all other respects to the 1501 except for its disk storage capability, which usually makes additional minitape drives unnecessary. The disk is used to hold batched data, which can be retrieved selectively for key verification, if required, and sorted and edited before being output to an industry-compatible magnetic tape or to a data communications line to the host computer system.

The 1502 is a desk version of the 1501 with similar capabilities. The main differences between the two are that the 1502 has a 1,920-character display (as compared with the 256-character display of the 1501) and provides a separate numeric keypad on its typewriter keyboard. The 1502 has a 16K-byte memory as standard. Minitape cartridge drives are mounted vertically on the right-hand side of the user workstation. An additional pair of drives can be added optionally.

The 1503, the most powerful of the 1500 terminals, can support up to 12 1501 terminals and up to 20M bytes of disk storage on-line. The 1503 has a 16K-byte memory with a 300-microsecond cycle time, and 2.5M to 20M bytes of fixed disk storage on one to four drives. The terminals can consist of one display with a 1,920-character screen on one cluster controller for four 256-character key display stations. Memory is expandable to 32K bytes and disk storage is expandable to 20M bytes in 5M-byte modules. Each module has 2.5M bytes of fixed and 2.5M bytes of exchangeable disk storage.

When data entry is too great for one keyboard to handle, the 1503 may be used as a controlling processor for up to 12 other 1500 terminals, all having access to the common data base disk files of the 1503. Although it is possible for the terminal to support up to 64 satellite terminals, practically it can support up to 12 terminals. Technical specifications are presented in Table 2.

Table 2. ICL 1500 Models: Specifications

Processor	
Word Length (bits)	8
Cycle Time (usec)	0.3
Instruction Set	45
No. of I/O Chan	1
Max Devices/Chan	63
CRT Display	
Char Set	64
Page Printer	
Char Set	64
Max Char/Line	132
Rated Speed (cps)	30, 165, 330
Other Peripherals	
Line Printers, lpm (132 col)	125, 220, 300, 400
Card Readers, Punches	RPQ
Paper Tape Readers, Punches	RPQ
Mag Tape Units	7-track, 556/800 bpi; 9-track, 800/1,600 bpi; 12.5 ips
Data Communications	
Mode	HDX
Timing	Async/sync
Data Rate (bps)	75 - 9,600
Interface	RS-232-C; CCITT V.24
Error Control	VRC/LRC or CRC
Compatibility	
Computer System	ICL System Ten, 1500, 2903/2904; IBM S/3, 360, 370; CDC 6000, Cyber; Honeywell 60, 100, 200, 2000, 6000; Univac 90, 1100, 9000
Term. Emulation	IBM 2780, 2968, 3780, 360/20; CDC UT 200; Honeywell Series 15, G100; Univac 1004

Processor

ICL currently supplies the 1500 as a complete hardware/software entry package. The system is programmable, however, allowing the manufacturer to develop a number of other applications and support for user programming through appropriate software. The processor architecture uses stack manipulation to optimize byte handling, provide automatic threading of recursive subroutines, and process graphics data efficiently. The basic instruction set includes 45 instruction codes plus an I/O instruction set; the instruction cycle time is 3 microseconds. The register set includes an accumulator, a stack pointer, and seven index registers for each 2K words of memory. The Instruction Address Stack allows for 16 members. The word size is eight bits and memory ranges from 8K bytes to 16K bytes. The processor includes a hardware bootstrap loader.

Keyboard

The standard keyboard includes alphanumeric and function keys assembled in the familiar keypunch ar-

rangement. However, when the 256-character display unit is attached, the keyboard keys can be assigned any desired meaning, since the actual data code assignments are accomplished by table look-up techniques within the controlling software. With the 256-character display unit, specially configured keyboards can be easily substituted for the standard keyboard. Typewriter-style keyboards are available for the 1502 and 1503 models.

Display

The display comprises a 5-inch CRT with its associated electronics. Up to 256 characters, each produced via a 5 x 8 dot pattern, can be displayed on the 1501; up to 1,920 characters can be displayed on the 1502 and 1503. The processor memory stores the dot patterns for each character; the screen is refreshed directly from memory. Display functions are under processor control.

Dual Magnetic Cartridge Drive

The built-in magnetic cartridge drive includes two independent tape transports that provide reel-to-reel handling of 75- or 150-millimeter tape that is housed in specially designed cartridges, 100 or 200 feet of tape per cartridge. Tape threading is automatic; 1,600 bits per inch are phase encoded on a single track. Tape formatting, read forward/backward, and read/write checking are under processor control.

Peripherals

A number of printers are offered. The 1550-1 impact printer operates at 30 characters per second using a standard ASCII 64-character set. Line length is up to 132 columns. The 1551D and S are character printers that print at up to 330 and 165 characters per second, respectively. Both print 132 columns using an ASCII character set. Line printers of the type used on the System 10 are available for the 1500; all print a 132-column line and use the ASCII 64-character set. Printer speeds are: 1553 — 125 lines per minute (lpm) 1554 — 220 lpm, 1555 — 300 lines per minute, and 1556 — 400 lpm.

Model 1511, 1512, 1513, and 1514 tape drives all operate independently of each other rather than being grouped into a subsystem. The first two use 7-inch reels; Model 1511 is a 7-track, 556/800-bit-per-inch unit, while Model 1512 records 9 tracks at 800 bits per inch. Models 1513 and 1514 are both 9-track drives using 10.5-inch reels recorded at 800 (NRZI) and 1,600 (PE) bits per inch respectively. All four tape drives operate at a speed of 12.5 inches per second. Paper tape equipment and card readers are available on an RPQ basis.

SOFTWARE

ICL provides the user with prepackaged programs stored on tape cartridges to control the system functions. The basic software systems include general data entry, advanced data entry, and complex forms data entry-editor. Binary synchronous and asynchronous communications control, sort/merge, copy file utility, high-speed search, off-line print, and update generator packages can be obtained to support basic system functions. In addition, the 1500 terminals can support the high-level languages, BASIC and COBOL. Models 1501-40 and 1503 can also support general accounting application packages supplied by ICL.

Entry Packages

The entry packages all allow the user to easily generate format control programs that will guide the entry process in a way similar to the program card on a keypunch. Programming of the field occurs in the same positions as the field in the data entry mode. Note that programming can be multilevel, but if more than one control code is to act on data falling into a particular position in memory, there must be more than one program.

Three entry packages are offered and differ in the types of checking available and the degree of control exerted over the entry process by the software. Descriptions are as follows:

- General Data Entry — provides formatted (single-level) or unformatted data entry and sight or key verification; includes standard keypunch/keytape functions such as automatic skipping and duplication, field balancing, automatic program selection, editing, blocking, and record searching.
- Advanced Data Entry — provides multiple formats, more elaborate checking, and computations on data during the entry process; includes add, subtract, multiply, accumulate, and recalculate as well as range and table generation checking, table look-up and comparisons, edit tables, omission detection, a retrieval table, date checks, constant store and retrieval, entry saved and restored, format revert (linkage), and peripheral edit.
- Complex Form Data Entry-Editor — provides highly controlled complex entry forms; includes single-character validity checks, program-controlled data flow, coding to indicate both the type of error and the related field, forward and backward format chaining, and data field checking, including calculation, verification, and inter-field checking.

The entry of format program(s), even multilevel ones, is eased by preprinted control cards. Once entered and stored on tape, they can be called up by the operator through a keyed code. Up to eight 120-character formats can be stored on a single cartridge. As the entry process proceeds, prompting messages guide the operator.

A fourth data entry system, the Business Transaction Language (BTL) System, can operate with Model 1503

or Model 1501-40 in standalone or clustered mode. The BTL System allows users to create programs using the high-level BTL programming language.

Communications

The purpose of the communications programs is to allow Model 1500 terminals to communicate with other data processing equipment over telephone lines. The 1500 terminals provide communications between two 1500 workstations, between a 1500 terminal and a central computer, and between a 1500 terminal and any device with data transmission capabilities. Transmission can be synchronous or asynchronous. The asynchronous programs handle Teletype and most Teletype-compatible devices, such as Telex. Synchronous communications programs include IBM bisynchronous communications generators and emulators.

Utilities

A number of utility routines support the format generator and data entry and data verify programs of the packages. The General Edit package transfers data records from cartridges to computer-compatible tape. Recalculate reads a data tape and reperforms all arithmetic functions specified by the format tape. The Copy File utility allows the user to manipulate tape files on cartridges or computer reels, including copying selected, partial, or complete files; it permits copying up to or starting at a specified record, display of individual records, and adding records to the end of a file, among other operations. Sort/Merge allows the user to sort or merge cartridge tape records and write them to either cartridge or computer tape. The High-Speed Search and Update Generator provides the user with file inquiry and selected record updating.

Assembler Programs

A group of six Assembler programs allows a programmer to write programs for the 1500 terminals. The programs written in Assembler are entered through the keyboard, edited, and converted to an object program on a tape cartridge. The Assembler includes the background routines required for terminal operation, and transfers the routines to the object program tape.

COMMUNICATIONS INTERFACE

ICL supplies as options two communications interfaces, the 1534 Asynchronous and the 1535 Synchronous Communications Adapters. The 1534 allows use of Teletype and existing high-speed communications networks. It transmits at speeds from 75 to 1,800 bps. The 1535 allows the system to communicate in the half-duplex mode over switched or leased communications networks with any computer at speeds up to 9,600 bps. Communications may be between 1500 terminals, 1500 and ICL mainframes and 8900 key-to-disk devices, as well as 1500 and non-ICL mainframes. A version of the Asynchronous Communications Adapter, the 1534-1, can be used for concentration to the serial I/O interface. Both the 1534 and 1535 are available with or without the unattended answer feature.

MAINTENANCE

TRW Inc. of Los Angeles CA maintains support for the 1500 terminals. ICL provides a 90-day warranty on 1500 systems.

PRICE DATA

Model	Description	Purchase Price $	Monthly Rental (1-yr) (Maint not Incl) $
1501	8K bytes, 256-char display, dual minitape drives	5,200	152
1501	16K bytes, 256-char display, dual minitape drives	5,400	158
1501-40	16K bytes, 256-char display, 2.5M-byte disk	13,623	400
1502	8K bytes, 1,920-char display, dual minitape drives	9,720	285
1502	16K bytes, 1,920-char display	10,373	305
1503	16K bytes, 256-char display, dual minitape drives	18,000	529
1503	16K bytes, 1,920-char display dual minitape drives, 2.5M-byte + 2.5M-byte fixed exchangeable disks	20,100	591
1503	External numeric keypad	286	7
1533	External dual minitape drives	1,917	56
	Uninterruptible power feature	2,923	85
	Printers		
1551-S	Matrix Printer: 165 cps	6,600	194
1551-D	Matrix Printer: 330 cps	8,510	250
1553	Line Printer: 125 lpm	12,515	368
1554	Line Printer: 220 lpm	14,000	411
1555	Line Printer: 300 lpm	14,304	420
1556	Line Printer: 400 lpm	16,052	472
	Magnetic Tapes		
1511	Mag Tape Unit: 7-track, 556/800 bpi, 7-in. reel	6,611	194
1512	Mag Tape Unit: 9-track, 800 bpi, 7-in. reel	6,611	194
1513	Mag Tape Unit: 9-track, 800 bpi, 10.5-in. reel	8,778	258
1514	Mag Tape Unit: 9-track, 1,600 bpi, 10.5-in. reel	13,327	391
	Disk Drives		
1543	Fixed & Exchangeable Disk Drive: 2.5M + 2.5M-bytes (max of 4 drives)	9,533	280
	Communications		
1590	Interface for up to 6 term.	1,700	50
1590	Interface for 6 addnl term.	500	14
1534	Async Comm Adapter: 75 - 1,800 bps	400	11
1534-1	Async Comm Adapter: 75 - 1,800 bps to serial I/O	1,508	44
1534-2	Async Adapter: Telex	1,729	50
1535	Sync Comm Adapter: 600 - 9,600 bps	400	11
1538	Auto Dial	1,000	29
1539	Sync Adapter	911	26
1517	Paper Tape Reader	6,010	176
1531	Card Reader	6,400	188

Quantity discounts and three-year and five-year rentals are available. Consult TRW for maintenance prices.

MAGNAVOX GOVERNMENT & INDUSTRIAL ELECTRONICS CO.

Orion-60 Plasma Display Terminal

77—15

OVERVIEW

The Magnavox Orion-60 Plasma Display Terminal, introduced at the 1976 National Computer Conference, represents a new and exciting development in interactive display terminals that bears watching. It is the first commercial application combining a microcomputer and plasma technology in a low-cost graphics terminal. If the terminal proves successful, it could lead the way for increased use of the plasma panel as a display medium. ("Plasma" is a scientific term referring to an ionized gas containing about an equal number of positive ions and electrons. A "plasma panel" consists of two pieces of glass separated by neon gas, which has the property of becoming illuminated when electronically excited. The resulting illumination is referred to as the "plasma display.")

Based on the Magnavox 12000 microcomputer terminal introduced in 1975 and used extensively in the University of Illinois Plato computer-aided instruction project, the Orion-60 is the first plasma terminal to be priced in the mass-marketable range. It features a streamlined cabinet design and a $5,995 price tag, which puts it in competition with conventional graphics terminals now on the market. The combination of a graphics capability, microcomputer, touch panel, and alphanumeric keyboard make the Orion-60 suitable for any application requiring pictorial presentation and a data entry capability.

Deliveries are scheduled for the first quarter of 1977.

COMPATIBILITY

The Orion-60 can interface with the Hewlett-Packard 2100 Series, IBM 360/370, Data General Nova, DEC PDP-11, and most EIA-compatible systems and peripherals, either by direct connection to the RS-232C computer port, or through the built-in RS-232C interface for remote communications. The Orion-60 operates in asynchronous, full-duplex mode. Data rates, character lengths, parity, and number of stop bits are switch selectable. Typical data rates are from 50 to 2,400 bps, which amounts to the transmission of 240 characters or 80 vectors per second. See Table 1 for specifications.

Table 1. Magnavox Orion-60: Specifications

Display Unit	
Type	Plasma Panel
Size (in)	8.5 x 8.5
Viewing Area	8.5 x 8.5
Brightness	30-ft-lamberts (point)
Resolution	60 lines/in
No. of Lines	32; 51 opt
Chars/Line	64; 85 opt
Phosphor Type	NA
Display Processor	
Resolution Addressability	512 x 512 dot matrix
Vector Drawing Rate	80 vectors/sec
Character Drawing Rate	240 char/sec
Char Size	7 x 9; 5 x 7 opt
Char Set	ASCII 96 symbol subset; 128 programmable symbols, GRAPHICS code
Screen Erase Time	20 μsec
Interactive Devices	
Keyboard	Yes
Light Pen	No
Other	Touch panel, tablet
Communication Interface	
Local/Remote	Both
Type	RS232C, to 2,400 bps, full-duplex
Other Features	Microprocessor firmware options and graphics software packages

PERFORMANCE AND COMPETITIVE POSITION

The most important innovation is the large (for a plasma) 8.5-square-inch display panel. The acceptance of this form of image processing will determine the success

HEADQUARTERS

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of the Orion-60. The technical features of the plasma panel offer a combination of storage tube capabilities along with dynamic generation and modification of displayed data. Each element of the display is uniquely positioned in exact geometric relation to all other elements by a matrix of electrodes located on the inner surface of the glass plates. Since each element can selectively be written or erased, complex displays can be constructed and modified rapidly without the need for erasing the screen and starting over.

No refresh buffer is needed, as with conventional CRT-based terminals, and since each individual display element can be addressed for writing or erasing without disturbing other information, such unpleasant effects as flicker, jitter, point distortion, and tear-dropping are eliminated. The result is a stable display that can be viewed without eye fatigue for long periods of time. Other points of comparison between the CRT and plasma displays are summarized in Table 2.

The touch panel provides an additional means of data entry known as "menu-picking," which is common in interactive computer-aided design applications. Menu-picking is an efficient form of data entry and should find acceptance in other graphics and business applications. Under this method, the user calls up a menu, or list, on the display, and by touching the desired processing function on the display with his finger, can call specific programs into operation instead of having to type in a string of instructions or use light-pen devices.

The question of resolution is difficult to resolve for the user without viewing the panel in terms of a specific requirement. According to Magnavox, for some applications the information content of the plasma screen equals that of high resolution raster, the traditional technology of computer-aided graphics design. (A raster produces an image similar to that seen on a home TV viewing screen).

For graphics applications, the Orion-60 is priced lower than the raster-based terminals ($8,000–$15,000 price range) such as the Hughes Conographic and the Princeton Electronic Products 801; higher than the popular storage tubes from Tektronics, like the 4006-1 at $3,000 and the 4010-1 at $4,200; but competitively with the Tektronics 4012 and 4013 at $6,000 and $6,200 respectively.

Aside from price considerations, the prospective user should investigate the advantages and savings offered by the microprocessor. This built-in intelligence should be fully exploited. The Orion-60 is available with such options as extended character sets, firmware emulators (e.g., Tektroniks) and other control functions which are handled at the terminal level, without accessing the host computer's resources. This degree of distributive processing affords savings in processing time and program development.

Table 2. CRT and Plasma Panel Display Comparison Chart

	CRT DISPLAY	PLASMA PANEL DISPLAY
RUGGEDNESS	One piece of glass	Two pieces of glass
SAFETY	Vacuum subject to implosion X-radiation Voltage over 10,000v	No vacuum No x-radiation Voltage 90–150v (less chance of explosion in high oxygen atmosphere)
VIEWING SCREEN DEGRADATION	Phosphor eventually burns off the screen and leaves a dark spot	Dielectric coating (a nonconductor of direct electrical current) changes properties and cannot be illuminated. Magnavox expects that this degradation phenomenon will occur less rapidly than the analogous phenomenon on CRT screens, resulting in a longer service life.
VIEWING SCREEN IMAGES	No inherent storage capability Graphics modifications require erasing screen and starting over. Produces more delicate shading effects with multi-thickness vectors; lines and circles appear smoother than plasma for graphics. Beams, phosphors, and refresh buffers give rise to flickering, distortion, skipping, and tear-dropping.	Each display element is located on an electrode matrix on the inner surfaces of the glass plates. Each element is addressable and individual elements can selectively be erased without disturbing other information. Produces a continuous bright image, even in intense lighting, reducing eye fatigue.
REPLACEMENT	Nonmodular, recalibration required	Modular (can be unscrewed from mounting, remounted, and reconnected with no recalibration requirement)

SYSTEM DESIGN

Microprocessor

In addition to introducing the plasma panel as a graphics display medium, the Orion-60 incorporates an Intel 8080 microprocessor for operation and control. A single card contains the microprocessor, all control logic, vector generators, and other terminal functions previously supported by many discrete electronic components. The microprocessor allows for user-switchable options and a high degree of modularity for changing or expanding control functions, character sets, etc. The card contains 2K of RAM for special characters. Some firmware options include an APL character set, an extended ASCII set, variable character sizes, etc. The

microprocessor operates on each received character to execute a plot function or perform a control function. It supervises the control of all internal functions and communicates directly with the memories, display panel, and communications interface.

Software

There are presently three software packages available for the Orion-60 plasma display terminal:

- GPAC — Graphics Package. These are callable FORTRAN IV subroutines that allow the user to design applications programs for the terminal. This package is currently implemented for Hewlett-Packard 2100 systems, Data General Nova Series, PDP-11 systems running under the RT-11 operating system, and Control Data Corporation 6500 and 7311 systems.
- Hewlett-Packard 2000F Basic Software. This is available to HP users through the HP clearing house, and consists of subroutines to support the terminal. It provides communications with the higher level Time-Sharing Graphics Plotting Package for extended drawing capabilities.
- IGS — Interactive Graphics Software for IBM 360/370. This permits use of the terminal with IBM 360/370 systems, offering such graphics capabilities as windowing, scaling, notation, clipping, and mirror imaging. An additional benefit is a completely interactive California Computer Products previewing package which allows the user to display and alter CalComp plots and files before the actual plotting operation.
  Additionally, the programmable microprocessor may be reprogrammed with firmware options from Magnavox, affording the user compatibility with current graphics terminals such as the Tektronics 4010, 4012, 4013, and 4014 series.

Touch Panel

The Orion-60 can accommodate an interesting and innovative touch data entry panel. The touch panel provides a control feature whereby an operator may enter data from a displayed chart, or menu, by pointing at the panel with his or her finger. The touch panel mounts over the display area and consists of an array of LED optical sensors. There are 16 in both the X and Y directions, giving a matrix of 256 selections. When the operator places a finger on the panel, the finger interrupts an X-axis light beam and a Y-axis light beam. This address is coded and sent to the microprocessor, then to the central computer which interprets that code as having a specific meaning or function.

Keyboard

A keyboard provides standard 96-character ASCII plus all control characters. It is provided with a TTY Lock Mode so that the 64-character ASCII character set may be generated without shifting. The keyboard includes the cursor positioning keys and an 11-key numeric pad.

Character Generation

Standard alphanumeric characters are constructed on a 7 x 9 dot matrix format. In plotting sequence, the character generator positions each character within an 8 x 16 matrix providing line-to-line and column-to-column spacing between characters. This also provides the spacing necessary for line descenders on lowercase characters, subscripting, and superscripting.

Standard screen capacity is 2,048 characters arranged in 32 lines of 64 characters per line. By generating smaller characters, on a 5 x 7 matrix, the total screen capacity is 4,335 characters arranged in 51 lines of 85 characters per line. The full 128-code ASCII character set is available, with 96 being printable and 32 used for control information. Another standard feature of the Orion-60 is the user-programmable character set which permits the user to define up to 128 special symbols and to load them into user-programmable random access memory.

There are four character printing modes:

- Normal — erase all background in matrix and write desired symbol.
- Inverse — write all background in matrix and erase desired symbol.
- Overstrike — do nothing to background and write only the dots defined in memory for the desired symbol.
- Erase — do nothing to background and erase only dots defined in memory for the desired symbol.

A cursor is always written whenever the terminal enters the ASCII mode of operation. When entering characters, the cursor is always written ahead of the last character printed and points to the center of the next character.

During operation, a number of automatic control functions assure reliability of the data. An anti-wraparound feature, which operates in both a vertical and horizontal direction, prevents a partial character from being written. This is done via a look-ahead algorithm that detects the edge of the display area. The Page Full Break feature is a switch-selectable function that provides an automatic interrupt when a full page of text has been displayed. This prevents the overprinting of additional data. The terminal also permits the underlining of previously displayed data without altering the text.

Vector Generation

While the ASCII mode permits the display of alphanumeric characters, the Graphics Mode enables the terminal to perform vector plots and other special functions. Vectors may be drawn in two modes: as long vectors, or plotted as successive points. In the long vector mode, lines

may be drawn to any point at the rate of 80 vectors per second. The line is drawn from the current X,Y location to a new X,Y location. All vectors, regardless of length, are drawn at the maximum rate of 80 per second.

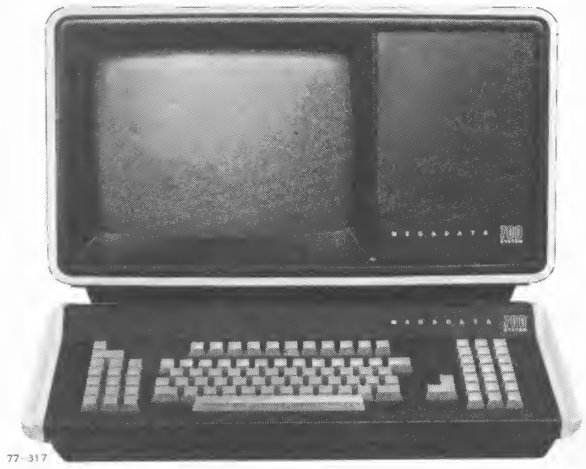
In point plotting mode, a three-byte data sequence specifies a set of X,Y coordinates for a single element to be written or erased.

An optional firmware incremental vector routine permits the drawing of vectors as incremental lines, a specified distance and direction from the current point.

PRICE DATA

Description	Purchase Price (Maint. not Incl) $
Orion-60 Plasma Display Terminal: includes plasma panel & power supply; vector & point plot graphic modes; 128 ASCII keyboard; alphanumeric character generator with printing modes; full-duplex RS232C interface; switch-selectable interface functions — baud rate, page full break, local echo, stop bits/ character, word length, parity; plus 128 user-definable characters	5,995
Touch Panel — plug-in 16 x 16 entry matrix	850

MEGADATA CORP
System 700



OVERVIEW

The Megadata System 700 is a line of versatile standalone intelligent display terminals delivered as a turnkey installation, including all application software, or as a user programmable system capable of performing data entry, remote batch, transaction processing, text editing, etc. Each standalone version of the System 700 contains a full scale 12-bit processor (MSI/LSI and microprocessor). Megadata characterizes itself as an applications-oriented terminal supplier.

Basically, Megadata is offering a custom-tailored intelligent display terminal. Systems will be built to a customer's own specifications if desired, thereby offering greater flexibility than is currently offered by the majority of other manufacturers of intelligent terminals. Megadata is offering System 700 models in a broad range of applications, which are finding a wide variety of markets in addition to the usual data entry terminal market.

The keyboard configuration consists of up to 126 key stations and 12 status indicators. Specifics of each key are specified at the time of the order. The keyboard consists of 71 programmable function keys and 55 alphanumeric keys. Nearly every aspect of the system is defined by choices — a programmable character generator permits display of virtually any character/symbol set, choice of display sizes, and so on. As a result, the system can be adapted to a variety of uses through custom tailoring or through user programming which is DEC-PDP8E compatible.

The System 700P is the basic system with a standard black-and-white CRT display delivered as a turnkey system. The System 700S is the basic system delivered as a user programmable system. There are 10 other variations of the System 700 designed for specific user applications. See the SYSTEM DESIGN section for details. All systems can attach cassette drives, diskettes, printers, paper tape I/O, and so on. Up to three interfaces are available for attaching peripherals. Also, a parallel data channel rated at up to 10K characters per second is available. A variety of communications line disciplines, speeds, and interfaces are available to adapt to communications environments. Table 1 shows system specifications.

PERFORMANCE AND COMPETITIVE POSITION

Introduced in 1976, the System 700 takes the place of the earlier SiR-1000 Series of turnkey intelligent terminals, and offers the customer more memory and a lower cost than the SiR-1000, as well as a detachable keyboard. The system is marketed directly by Megadata in the United States. In Europe, the system is marketed by Eurotech, which is a division of Cable and Wireless, Ltd. Canadian marketing is handled directly by Megadata.

Megadata terminals are similar to the standalone terminal systems offered by Sycor, Zentec, Datapoint, Computek, and others, and offer a price advantage with certain configurations. Megadata's marketing policy places emphasis on the custom tailoring provided by the manufacturer and the variety of offerings in the turnkey models, in addition to the user programmable system. Cost and performance comparisons are difficult because of the relationship they bear with individual applications. The ability to code user programs relieves the customer of the cost of tailoring existing software provided with turnkey systems. Unquestionably, customized systems are more expensive on a one-to-one basis, but customizing costs can be mitigated by price savings negotiated for large numbers of terminals.

HEADQUARTERS

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The Megadata System 700 offers the customer greater flexibility over its previous systems for a number of reasons: 1) it is offered as a turnkey system in a variety of applications; 2) it can be customized by the manufacturer; and 3) it may be programmed by the user to meet the demands of their environment. The ability of this system to interface with virtually any mainframe and Bell System modem eliminates Megadata's previous shortfalls.

Table 1. Megadata System 700: Specifications

Processor	
Memory Type	MOS, PROM, and RAM
Memory Size (words)	4K std to 73K opt
Word Size (bits)	12
Memory Cycle Time (μsec)	3.048
No. of Addressable Registers	4
No. of Instructions	100 microinstructions, 8 basic groups
No. of I/O Ports	Opt
Max. No. of I/O Devices	No limit
Display Unit	
Screen Size (char)	To 1,920 std
Characters/Line	80 std, 128 opt
Lines/Display	24 std, 32 opt
Character Sets	ASCII (64) std, 96 or 128, 256 opt
Character Generation	7 x 8 std, 7 x 9, 8 x 10, 8 x 12, 10 x 15, 12 x 15, 10 x 23 opt
Buffered	80 char
Graphics	10 x 10 std, 10 x 12, 10 x 15 c 12 x 16 opt
Keyboard	
Layout	Detachable, Selectric-type, keyboard layout specified by customer
Keys	To 126 plus 12 status indicators, up to 71 programmable function keys
Code Generated	ASCII
Peripherals	
Printers	30, 120, 160 cps, 200, 300 lpm high speed printers
Tape Cassette	Single or dual, 125K char/cassette
Floppy Disk	Single or dual, 250K bytes/disk
Paper Tape Reader/Punch	5, 6, 7, or 8 level
Hard Disk	Single or dual, 6.4 million/disk
Communications	
Transmission Code	Baudot, ASCII, BCD, EBCDIC, others
Line Interface	RS-232-C, RS-422, NRZI, TTL, EIA-CCITT
Data Rate (bps)	50-9, 600 to 19.2K
Synchronization	Async or sync, BSC, SDLC
Mode	HDX or FDX
Line Discipline	IBM 3270, 4100/200, others
Compatibility	
Computer System	IBM 360/370, Univac 1100, Burroughs 5500, CDC, HIS, Sigma, ICL, others
Terminals Emulated	IBM 3270, IBM 2260, Uniscope 100/200, Hazeltine 2000, TTY, others
Bell Modem	201A/B, 103A, 202C
Software	Assembly language, compatible to PDP8E
First Delivery	1976

CONFIGURATION GUIDE

The basic Megadata System 700 consists of a keyboard and a CRT display with a full-scale 12-bit microprocessor and 4K 12-bit words of memory (PROM and RAM) in a standalone desktop configuration or a rack-mounted version. A black-and-white video CRT is standard; a color monitor is optional. In addition to this basic terminal, the System 700 can be equipped with any combination of interfaces: a communications or parallel data channel interface and two device interfaces for a printer, tape cassette, 1/2-inch industry compatible tape drive, a diskette, and a paper tape reader/punch. Megadata indicates there is no real limit to the number and type of peripheral devices that may be attached; the usual configuration consists of three.

The user can obtain either the basic System 700 or any of the following models, which are variations of the System 700.

- Model 700/NW — a turnkey system providing sophisticated newsroom text preparation and editing, message switching and data communications. The system can interface more than one data link simultaneously while operating in entirely different data codes and data rates. Most applications are configured with "master" and "slave" display stations.
- Model 700/TE — available as a user programmable or turnkey text editing/word processing terminal offering a display format of either a split screen or full screen. An optional programmable character generator permits the terminal to display any desired character shape, style, font, or design.
- Model 700/TS — an applications-oriented touch screen terminal which provides the user with a touch resolution of 240 points or "pads". The system is Rs-232-compatible and operates asynchronously at speeds from 75 bps to 38.2Kbps.
- Model 700/LD — a legal and legislative document composing/editing system.
- Model 700/CT — available as a user programmable or turnkey communications system designed for use by banks, airlines, and national/international message switching. The terminals are plug-to-plug compatible with existing communications networks. The system is configured for each individual application.
- Model 700/AF — designed for use in business systems applications such as accounting, auditing, inventory control, and similar data base management systems.
- Model 700/QP — a multi-function terminal combining communications, reservations, and credit authorization operations from the same unit.
- Model 700/GC — a graphics/color display terminal for process control, telemetry and other industrial and scientific applications.

- Model 700/UPS7 — a user-programmable stand-alone system containing a floppy disk of 250K bytes of storage or a 6.5M-byte hard disk, and a 60- or 110-character-per-second printer. Communications modes through RS-232 interfaces are asynchronous, synchronous, or bisynchronous. Programming features include a terminal editor, interactive debugger, command interpreter, and Assembly language. An optional programmable character generator which permits the terminal to display any desired character shape, style, font, or design.
- Model 700/UETS — a user programmable system which can emulate any five terminal protocols. The system can operate under IBM's Binary Synchronous Communications (BSC) and has RS-232 and RS-422 interfaces. The system's operating parameters and telecommunications routines may be upgraded or changed if the user implements a different host computer.

It should be stressed that the following descriptions of the central processor, peripherals, and interfaces are only outlines of what the manufacturer has currently available.

Central Processor And Memory

The System 700 contains a full-scale 12-bit microprocessor with multi-task interrupt base processing and a 3.048 microsecond memory cycle time, similar in architecture to the DEC-PDP8E. There are eight basic instruction groups comprising approximately 100 microinstructions, which are DEC-PDP8E-compatible.

Memory is typically separated (in a 4K system) into 32 "pages," with each page containing 128 words. The first two pages of every field of memory are RAM; the remaining 30 pages of every field of memory are PROM. Memory can currently be expanded to 64K total CPU memory. External memory can be added for display uses as needed.

Keyboard Display

The terminal display may be ordered as a black-and-white character display or as an optional color display that is also capable of graphics. Both displays can handle up to 24 lines of up to 80 characters each, for a total of 1,920 characters in standard form. The display is optionally expandable to a maximum of 32 lines of up to 128 characters, depending upon dot matrix pattern requirements. The data buffer is variable in length up to 8K characters. Character capacity for individual models may vary — the Model 700/NW, for instance, has a high resolution dot matrix of 8 x 12 and a display format of 20 lines of 80 characters each.

Characters are generated on a 7 x 8 dot matrix, and are refreshed at a 60-Hz refresh rate. Graphics are generated on a 10 x 10 dot matrix. Up to 256 displayable characters are available. A programmable character generator permits display of virtually any character/symbol set or language. Standard screen capabilities include blinking data, inverted video (available only on an 80 x 20 or less screen size), strike through, underline video, suppress display, intensified video, communications symbols, and graphics. Editing functions depend on the model of the system. In the color version, the video is separated into one sync line and the three color video lines.

The various keyboard configurations depend upon the specific model of the System 700. A 126-key Selectric-type detachable keyboard with up to 71 programmable function keys and 12 status indicators under program control is usually used on the System 700 Model 700/UETS.

Other Interfaces

- Modem interface for asynchronous or synchronous communications of 50 to 9,600 bps; RTS-CTS turnaround logic.
- Hard-wired on-site asynchronous or synchronous interface; NRZI/TTL or RS-232-C levels; RTS-CTS turnaround logic up to 20,000 bps.
- Printer interface for asynchronous transmission; NRZI/TTL or RS-232-C levels; up to 20,000 bps; Printer Ready/Printer Busy/Printer Alarm controls.
- Tape cassette interface of 110 to 9,600 bps; NRZI/TTL or RS-232-C levels, full control of read/write cycles, tape deck select.
- Magnetic tape interface, up to 1,600 cpi, internal or external formatter, NRZI/TTL levels.
- Floppy disk interface, input control, output status, data-write data input, read data output, NRZI/TTL levels.
- Parallel data channel interface, up to 12 data lines, unidirectional or bidirectional, addressable data bus, up to 10,000 cps, NRZI/TTL levels.

SOFTWARE

The System 700 is delivered either as a turnkey system, where Megadata provides all application software, or as a user programmable system where the customer writes his own applications programs which are supported by the Megadata operating system. The processor architecture consists of a 12-bit minicomputer with multi-task interrupt base processing similar in design to the DEC-PDP8E. The software consists of eight basic instruction groups comprising 100 or so microinstructions, which are PDP8E compatible. Program

storage is attained through either PROM or loading the programs from a host CPU (downstream loading).

MAINTENANCE

Megadata does preventative and emergency maintenance on terminals in New York and California. Terminals in other areas are serviced through contracts with third party maintenance firms such as Indeserve. (Leasing is also done through a third party with full payout arrangements.) Maintenance contracts can cover a variety of situations, from prime shift to round-the-clock. Maintenance can also be done on a per-hour basis.

PRICE DATA

Prices for the Megadata System 700 models are as follows. Quantity discount pricing can be obtained from Megadata.

- 700 (Basic): $3,500.
- 700/NW: $4,500-$7,200.
- 700/TE: $4,500-$6,500.
- 700/TS: $6,000-$12,000.
- 700/LD: $5,500-$8,500.
- 700/CT: $3,900-$8,500.
- 700/AF: $4,250-$6,500.
- 700/QP: $4,500-$7,500.
- 700/GC: $4,850-$8,500.
- 700/UPS7: $14,500.
- 700/UETS: $6,500-$10,000.

MOHAWK DATA SCIENCES CORP.
Series 21 Distributed Information Systems

OVERVIEW

The MDS Series 21 is a family of processor-based systems, complemented by an expandable line of peripheral devices. Series 21 systems are designed to provide data entry and remote computing capability in a distributed processing network. Initially, the Series 21 family consists of two members, the System 21/20 and the System 21/40. System 21/20 is the lowest cost starter system in the family. It is designed for applications having a high percentage of data entry and validation work. System 21/40 is the next step up in the Series 21 family. A high-level user language allows the System 21/40 to be fully programmed for unique application processing.

Basic configurations consist of an operator station with 1,920-character CRT and keyboard, and a processor with one diskette drive. System 21/20 is preprogramed for data entry and validation under control of user-supplied formats. System 21/40 is fully programmable by the user via MOBOL (MOhawk Business Oriented Language) and can thus be adapted to a wide range of distributed tasks, from extended data validation to full transaction processing. Both System 21/20 and System 21/40 may be expanded to include four operator stations.

MDS supplies four types of software packages to control Series 21 operations: Formated Data Entry Program (FDEP), Customized Entry/Processing (MOBOL), Media Utilities, and Data Communications. FDEP provides a series of ready-to-use routines to facilitate the creation of data batches on IBM-compatible diskette media. FDEP includes routines for job definition, data entry, data verification, record search/update, and production statistics logging/reporting. The job definition routine allows the user to customize data entry procedures. The high-level language MOBOL enables local job turnaround from source data to completed transaction. MOBOL programs may be written and compiled either at the remote site or at a centralized location. Data Communication software is provided to allow the Series 21 to communicate with a wide variety of central computer configurations and/or another Series 21 device. Either BSC or SDLC communications protocols may be supported by the Series 21. While MOBOL may only be used with the System 21/40, the other software packages are compatible with all Series 21 processors.

Mohawk Data Sciences Corporation (MDS) is a New York Stock Exchange Company which was founded in 1964. MDS is the tenth largest manufacturing firm in the computer industry and the largest nonmainframe manufacturer. The MDS product line is one of the broadest nonmainframe equipment offerings in the industry. The product line includes data recorders, intelligent terminals, key-to-disk systems, preprocessors, remote job entry systems, and distributed processing systems.

PERFORMANCE AND COMPETITIVE POSITION

The first product used in early distributed processing networks was the Mohawk data recorders; consequently, MDS has extensive experience in developing products for distributed information networks. Mohawk feels that the Series 21 will have an impact on the industry similar to the one caused by the first data recorder. Certainly the Series 21 is a step forward in price/performance; however, the product would be significantly enhanced by more extensive software.

HEADQUARTERS

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A number of companies offer products similar in capabilities to the MDS Series 21. Four-Phase, Datapoint, CMC (now a division of Pertec Corporation), and Sycor represent a sampling of the major suppliers of equipment similar to the MDS Series 21. The Datapoint Diskette 1100 and the Sycor 350 are probably the closest comparable products with an installed base on the market today. The Series 21 offers similar capabilities for a lower price than the Datapoint and Sycor products.

For interactive data entry, Datapoint offers Databus/Dataform and Sycor offers TAL II software aids. For local data processing, Datapoint has an RPG II compiler. In the data entry/processing arena, the Series 21 is closer to the Datapoint and the more recently introduced Texas Instruments Model 770 tape cassette-based intelligent terminal in its two-tiered approach towards software for the distributed environment. The TI 770 has TPL 700 which provides a forms description and a procedures language similar to the Series 21 Forms Data Entry Program (FDEP) and MOBOL. Both allow the user to execute the procedural code when the appropriate field is entered, and both allow the user to write batch-oriented programs for local data processing. They are quite competitive in price; TI 770 is priced at $6,400, and the Series 21 at $6,270, both basic configurations. Unlike pricce-competitive Datapoint, Sycor, and Texas Instruments, the Series 21 offers a multistation (cluster) expansion capability and an industry-compatible magnetic tape handler. The price and performance of the MDS Series 21 make it an extremely attractive and competitive product.

USER REACTIONS

First deliveries of the MDS Series 21 Distributed Information System are scheduled for May 1977. As of publication, no significant user experience with the Series 21 has occurred. After the Series 21 has been installed for a sufficient period of time, the report will be updated to reflect user experience with the product.

SYSTEM DESIGN

The MDS Series 21 is a family of intelligent systems designed for local processing and utilization of information in a distributed environment. The Series 21 is modular in design and can be configured in a wide variety of ways. The basic components used in Series 21 configurations are described below.

CONTROLLER CONSOLE

The controller console is the central point for all Series 21 activities. It includes a processor, memory, all device controllers, and from one to four flexible diskette drives. The processor incorporates advanced MOS (metal oxide semiconductor) and LSI (large-scale integration) technologies. Memory is expandable to a maximum of 64K (System 21/40 only). A diskette controller is provided which can accommodate up to four integral diskette drives. One diskette drive is supplied as standard equipment, and three more can be optionally added to the controller console. One dual operator station controller is provided and one optional controller can be added, allowing for a maximum of four operator stations. Optional device controllers for magnetic tape, printer, disk drive, and communications are available.

OPERATOR STATION

The operator station is an interactive workstation which operates under program control. It consists of a 15-inch display screen, movable keyboard, interface logic, and power supply. It is designed for desk-top or table-top installations and can be located up to 200 feet from the controller console. One complete operator station is included with each base system. A maximum of three additional operator stations may be configured with any Series 21 system. In addition to standard English, keytops and display graphics are available to match the following character sets: Danish, Finnish/Swedish, French, German, Kata Kana, Norwegian, Portuguese, South African, Spanish, and United Kingdom. Both data entry and typewriter-style keyboards are available, each with optional numeric pad.

DISKETTE DRIVE

Diskette is the principal storage medium used with Series 21 systems. It is used for both program and data storage. A maximum of four diskette drives may be supported on any Series 21 system; one drive is supplied as standard. The diskette drives are housed in the controller console. If the system is used to compile MOBOL programs, two diskette drives are required. When a system is used under FDEP control and more than one operator station is used, one dedicated diskette drive is recommended for each operator station.

Diskette data transfer occurs at the rate of 31.2K bytes per second during read and write operations. The controller also provides CRC (cyclic redundancy check) on read and write commands. A maximum of 242,944 characters may be stored on a single diskette.

PRINTERS

A single printer can be attached to a Series 21 system. The printer may be located up to 20 feet from the controller console. Two model printers are provided for use with the Series 21. One model offers a 45-character-per-second speed with 96-character

graphic set, while the other provides a 150-character-per-second speed and 128-character graphic set. Both printers have 132 print positions. The printers may be optionally equipped with foreign language graphics compatible with the operator stations.

MAGNETIC TAPE HANDLERS

The Series 21 may be equipped with one magnetic tape unit. The 9-track tape drive may be either an 800 bit-per-inch or a 1,600-bit-per-inch industry-compatible unit. An MDS Model 1100 or 6400 Data Recorder (with the Mohawk Synchronous Communications feature) may be used in place of a magnetic tape drive.

DISK DRIVE

A disk drive with 2.5 megabyte character storage is offered in a freestanding unit. The disk drive unit may be located up to 20 feet from the controller console.

COMPATIBLE CHANNEL

A channel interface is provided to allow the attachment of a Series 21 system to another MDS processor. Series 21 may thus be treated as a peripheral to either the MDS 1200/2400 key-to-disk systems or an MDS 2300 local processing/RJE system. In this fashion, Series 21 can provide distributed processing functions in a data entry or remote job entry network.

A summary of the MDS Series 21 system specifications is presented in Table 1.

Table 1. MDS Series 21 Distributed Information Systems: Specifications

	System 21/20	System 21/40
CONTROLLER CONSOLE	Yes	Yes
MAIN MEMORY	N/A	32K to 64K
OPERATOR STATIONS		
Number per System	1 to 4	1 to 4
Keyboards:		
Type	Typewriter or data entry	Typewriter or data entry
Keys	66	66
Numeric Pad	Opt, 12-key	Opt, 12-key
Audible Tone	Yes	Yes
CRT Displays:		
Screen Size (in.)	15	15
Display Size	480 char	480 or 1,920 char
Upper/Lowercase	Yes	Yes
Character Set	128	128
Blinking Cursor	Yes	Yes
Number of Intensities	3	3
Blinking	Yes	Yes
Reverse Image	Yes	Yes
DISKETTE DRIVES		
Number per System	1 to 4	1 to 4
Capacity-Records/Diskette	1,898	1,898
Capacity-Bytes/Diskette	243K	243K
Format	Basic data exchange	Basic data exchange
PRINTERS		
Number per System	1	1
Speed	45 cps, 150 cps	45 cps, 150 cps
Character Set	96 or 128	96 or 128
DATA COMMUNICATIONS		
Protocols	BSC, SDLC	BSC, SDLC
Point-to-Point	Switched/ nonswitched	Switched/ nonswitched
Multipoint	Nonswitched	Nonswitched
Data Rates	600 to 9,600 bps	600 to 9,600 bps
Methods	Batch	Batch
SOFTWARE		
Formatted Data Entry Package		
Number of Program Levels/Job	1 to 10	1 to 10
Check Digits	2	2
Accumulators	4	4
Utilities	Yes	Yes
Communications	BSC/SDLC	BSC/SDLC
Compiler	No	Yes, MOBOL
COMPATIBILITY		
IBM 2780	Yes	Yes
IBM 3770	Yes	Yes
FIRST DELIVERY	May 1977	May 1977

N/A — Not Applicable

DATA COMMUNICATIONS

The MDS Series 21 is optionally capable of batch data communications at data rates from 600 bits-per-second to 9,600 bits-per-second, employing both BSC (Binary Synchronous Communications) and SDLC (Synchronous Data Link Control) protocols. Various modem interfaces are available to accommodate both North American, European, and other communications requirements, including satellite transmissions. Only one system per location need have the data communications option. Information captured or processed on affiliated systems can be transmitted via a single Series 21 by pooling diskettes, or by copying all diskettes to magnetic tape.

The following paragraphs describe the two data communications protocols available on the MDS Series 21 distributed information systems.

BSC PROTOCOL

BSC is an industry-standard communications technique, compatible with most major computer systems. BSC supports half-duplex communications over two-wire or four-wire facilities. Compatibility with the IBM 2780 is the initial system emulator. EBCDIC transmission code (with or without transparency) is available. Switched, dedicated, and multipoint communications are also supported.

SDLC PROTOCOL

SDLC is a relatively new communications protocol which provides faster, more acurate transmission of large files. Compared to BSC, SDLC communicates greater amounts of information in a given interval.

Error checking schemes are also more sophisticated than BSC. Compatibility with the IBM 3770 family of terminals, supporting half-duplex transmission, is planned for late 1977 availability.

SOFTWARE

To facilitate initial conversion and eventual expansion of its Series 21 Distributed Processing Systems, MDS has developed a two-level software system. Level one software is called Formatted Data Entry Program (FDEP), a facility which enables users to quickly convert existing data entry and media conversion formats from current equipment to System 21/20 without programming or procedural changes. Level two software is called MOBOL, a powerful Englishlike language that permits total application programming customized to individual user needs. MOBOL programs, which execute on System 21/40 processors, are supported by both a compiler and an interpreter for rapid program development.

FDEP is intended to provide the user with a rapid transition for existing applications. Up to 10 program levels per job can be specified by the user. Since each program level allows a user to describe individual records up to 128 bytes in length, the combined capabilities of the FDEP allow for a wide range of standard applications. The principal objective of the FDEP is to serve as a conversion aid from existing data entry equipment such as keypunch or key-to-tape to the Series 21. The inherent simplicity of the FDEP allows existing data entry applications to be converted in a matter of hours to the Series 21.

The FDEP software permits the keyboard operator to utilize one of four major processing modes. The four FDEP processing modes are: data entry, data verification, search/update, and job definition. The following paragraphs describe the major FDEP processing modes.

DATA ENTRY MODE

Data entry mode is an application-oriented keyboard-to-diskette function. It is used to create new information in a diskette data set. As the operator keys information, the data is displayed and stored in a buffer until the record is completed. While the next record is being keyed, the previous record is written to the diskette. A limited amount of data editing, including check digits, boundary checking, field minimums, "must file," batch balancing via accumulators, and numeric or alpha validation, is provided by the FDEP software.

DATA VERIFICATION MODE

The data verification mode is used to check the accuracy of data records that have been previously recorded on diskette and to make corrections when errors are found. The process of verifying data is similar to that of entering data. As the data for a record is rekeyed from the source document, each character is automatically compared with the corresponding character in the record in the current record buffer. If the characters do not compare, a "miscompare" error occurs, and the operator is required to correct it before continuing verification.

SEARCH/UPDATE MODE

The search/update mode is provided to locate a specific record in a data set. Once the record is located by the system, it is displayed in its entirety. An update operation can be performed starting with the located record. Any field in the record may be changed by the operator. If the record was changed by the operator, the system rewrites the updated record to the diskette.

JOB DEFINITION MODE

The type of data entered into the system and the manner in which it is organized into records is controlled by a user-supplied job definition. A job may consist of from one to 10 display/record layouts, each referred to as a progam level. Each program level contains the keying, display, and validation requirements associated with one record (diskette sector). Under control of a single program level, a maximum of 128 data characters can be captured, organized into one to 20 data fields. The remaining screen positions are used for information such as field labels, prompting messages, and field separations to enhance screen readability. The job definition is stored as a diskette data set and is loaded as required.

FDEP provides a facility which measures various productivity factors. These measurements take the form of keystroke and record counters. Counters are maintained to monitor total keystrokes and keystrokes used during verify and update modes. Records processed in entry, verify, and update modes are counted. In addition, a count is maintained of all records inserted and deleted, and these are displayable at any operator station.

MOBOL is a multipurpose language that allows users of Series 21 to greatly expand the applications handled at remote or central sites. Utilizing MOBOL, a user can perform functions not possible under FDEP, including:

- Advanced data validation, including provisions for such powerful editing and preprocessing functions as table lookup, range checking, and expanded accumulation, check digits, and other operator control and productivity aids.
- Local transaction processing, including creation and maintenance of local data bases, report printing, and actual data processing applications.

- Multitasked distributed processing, which allows up to four Series 21 operators to each work on a different job.

MOBOL is characterized by its easy implementation and use, for both programmer and operator. Most of the instructions are macrooriented; a single statement can define (or change) screen layout, display attributes, and field processing specifications. Similarly, in the event of an operator error, the user has the ability to tell the operator what mistake has been made and how to correct it, thus recovering the processing sequence. To implement applications under MOBOL, a user creates a source program on diskette using FDEP. The source program is then compiled, creating an object program. A minimum of 16K additional memory and two diskette drives are required to compile application programs on a System 21/40. Not every System 21/40 site need have compilation capability. For purposes of uniformity and control, corporate policy may prefer to use the central programming staff to write and debug application programs. Executable programs on library diskettes, each holding several programs, may then be communicated (or mailed) to remote locations.

A single user-written application program may be resident in System 21/40 at any given time. However, the programmer may define different processing jobs within the context of a single program to be performed by the same or mutiple operators.

MDS supplies a Media Utilities package with Series 21 distributed information systems. The Utilities package provides properly equipped Series 21 systems with a number of data transcription, diskette labeling, and device control capabilities.

DATA TRANSCRIPTION

Data transcription provides data set (file) transfers from an input device to an output device. In addition to a copy operation, three types of data transformation can be employed during data transfer. The first is print operation, recognizing carriage control conventions; the second is decompression of "card images" containing up to 128 characters; and the third produces a hexadecimal dump representation of the input data set.

DISKETTE LABELING

Using the diskette labeling functions, diskette volume and data set labels can be displayed and/or written. Two separate functions are provided, one for volume labels and one for data set labels. Both labels conform to Basic Data Exchange conventions.

DEVICE CONTROL

Device control is a set of routines that allows the operator to perform external peripheral operations from the operator station keyboard. The device control routines are designed to operate with magnetic tape drives and printers.

MAINTENANCE

Maintenance for the Series 21 is provided by Mohawk Data Sciences Corporation. MDS sells and services the Series 21 from a network or 300 offices located throughout the United States, Canada, Europe, and South Africa. The lease price for the Series 21 includes charges for maintenance. Separate maintenance contracts are available for purchased equipment.

PRICE DATA

Model Number	Description	Monthly Rental (Incl Maint.) 1-yr	2-yr $	3-yr	Purchase Price $	Maintenance $
21/20	Data Entry System — includes Controller Console, 1 Operator Station, 1 Diskette Drive	158	148	130	6,270	32
21/40	Application Processing System — includes Controller Console, 1 Operator Station, 1 Diskette Drive, 32K memory and programmability	193	181	158	7,660	39
160	Programmability (upgrades 21/20 to 21/40)	35	33	28	1,390	7
164	16K memory	28	26	23	1,175	10
165	16K memory-2nd	28	26	23	1,175	10
2171	Diskette Drive	37	35	30	1,459	75
201	Data Communications	16	15	13	623	8
2192	Operator Station	45	42	37	1,978	20
191	Dual Station Controller (needed for 3rd operator station)	12	11	10	506	2
910	Numeric Pad	3	3	3	153	NC
2141	45 cps Printer	108	102	89	4,293	27
2172	2.5MB Disk Drive/ Controller	195	183	160	7,712	55

NC - No Charge

MOHAWK DATA SCIENCES

2300 Document Processing System

OVERVIEW

The MDS 2300 System is an intelligent terminal system for data capture and forms preparation. The basic system consists of a processor, 4K bytes of memory, a CRT keyboard display, and a 230KB disc. More disc storage, a computer-compatible tape drive, one or two 3M cartridge tape drives, a card reader, and a variety of printers can be added to the basic system. Communications facilities are optional.

The 2300 System can be configured in four ways:

- Document Processing System (DPS) — for intelligent capture of source data with concurrent document preparation and/or transmission of edited files to central processor.
- Multipoint/Inquiry DPS — same as the basic DPS with the added ability to interrogate remote data bases in order to update local files.
- Remote Job Entry (RJE) — provides remote communications using IBM 2780/3780 or System 360/20 modes. Local media conversions and device control are supported.
- DPS/RJE Combined — basic DPS and RJE capabilities (non-concurrently) on the same system. Desired functions are selected via the CRT display.

As a source-data entry and document processing system, the MDS 2300 performs in much the same way as the IBM 3735 Programmable Buffered Terminal. It uses transmission procedures and formats compatible with the 3735, as well as the IBM 3735 Forms Description Programs (FDP), which are field-definition, document-oriented programs. The MDS user has three methods for preparing forms descriptions:

- MDS 2400 processor using the Document Processing Language.
- IBM System/360/370 FDP Macro Assembler.
- IBM 3735 Code Assembler on a System/360/370 or System/3.

All assemblers produce object code that can run on a 2300 System. Conversely, a subset of the MDS 2300 object

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HEADQUARTERS

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code also operates on the IBM 3735. FDPs are usually loaded through the telecommunication interface, but the 2300 can also load programs from the local disc, computer tape, or tape cartridge.

The MDS 2300, in its document processing configuration, is cost-competitive with the IBM 3735 and offers expanded facilities — more efficient source data entry operations, overlapped keying/printing, and local disc file storage.

As an RJE terminal, the 2300 is configured with a Model 2307 control unit, a 230KB head-per-track disc drive, an optional card reader, and a variety of printers. IBM 2780, 3780, and 360/20 emulators allow the 2300 to communicate at up to 9,600 bps.

While the 2300 System was initially developed as an IBM 3735 replacement system, it is now marketed on its own merits. Mohawk is offering the 2300 as a tool in decentralized environments; a network of 2300s could handle source data capture, remote processing, and telecommunications.

Mohawk Data Sciences specializes in computer peripheral and support equipment, particularly data entry and communications systems. It was formed to develop and promote key-to-tape keypunch-replacement systems, a success that snow-balled into the whole keypunch replacement market. The company expanded to develop OEM, replacement, and stand-alone peripherals. After acquiring the Atron 8-bit minicomputer facility in 1971, MDS introduced the 2400 peripheral processing systems based on Atron hardware. The 2400 Series has a number of configurations used for key/disc data entry, off-line printing, remote batch, intelligent terminals, and media conversion. MDS has also introduced other peripheral subsystems with varying degrees of intelligence, for instance, the 2501 off-line printing system.

The 2300 was first delivered in January 1974. System specifications are listed in Table 1.

Table 1. MDS 2300: Specifications

MICROPROCESSOR	
Memory Size (bytes)	4K (expandable to 12K)
Max I/O Channels	1
Devices Per Channel	2
Utilities	Form Description Programs; File Handling; Printing; Operator Tutorial; RJE Media Conversion
PERIPHERALS	
Cartridge Tape	Optional 3M cartridge drive
Magnetic Tape (½ in.)	9 trk, 800 or 1,600 bpi
Printers (cps)	30; 100
Punch Card (cpm)	400
Disc	230.4-921.6 Kbytes
DATA COMMUNICATIONS	
Line Interface	Sync or async
Control Procedures	BSC
Standard Features	Attended/unattended, data compression, multi-point/inquiry
DISPLAY UNIT	
Screen Size (char)	120
Characters/Line	30
Lines/Display	4
Paging	Continuous scrolling
Character Set	64
Character Generation	Print wheel
DATA TRANSMISSION	
Line Facility	Voiceband
Line Speed (bps)	1,200 async; 1,200-9,600 sync
Error Control	VRC/LRC
COMPATIBILITY	
Computer System	IBM System/360 Model 20, System/370 (135 and up)
Terminal	IBM 3735, MDS 2400
Bell System Data Set	201 A/B; 202 C/D
FIRST DELIVERY	January 1974

COMPATIBILITY

When equipped with the optional communication controller, the 2300 looks like a 3735 in every way. This means that the 2300 can use all 360/370 telecommunications access methods presently supported for the 3735, including TCAM under OS and BTAM under OS or DOS. Like the 3735, the 2300 can communicate with System/3. MDS 2300s can be mixed with IBM 3735s in a multipoint system.

The 2300 emulates the IBM 2780, 3780, 2968, and 360/20. It can communicate with an MDS 2400 or with another 2300. It can also communicate with Univac, CDC, or Honeywell/GE computers.

PERFORMANCE AND COMPETITIVE POSITION

The MDS 2300 joins a host of other intelligent terminals that have been introduced by both large and small manufacturers. The 2300 competes on two fronts: as an IBM 3735 replacement and as an intelligent source data entry station with limited remote batch capability, and as an RJE terminal.

3735 Replacement. The MDS 2300 without communication facilities is comparable in price to a communicating IBM 3735 that includes IBM's 42K-byte disc option; a basic MDS 2300 with communication facilities is slightly more expensive than the IBM system. The MDS 2300 includes a 230K-byte disc as a standard feature plus a small (9-inch), 128-character CRT, which is not available on the IBM system. The character printer operates at 30 characters per second, which is twice as fast as the Selectric on the 3735.

MDS has attracted customers with the 2300's greater storage capacity in a minimum configuration, and its range of software-supported peripherals that permit local printing and data storage.

Source Data Entry. Operators can key (upper- and lowercase alphanumerics) variable fields on a fixed form under program control, correct errors, and print out a finished copy. Because printing and keying can occur simultaneously, an operator can begin work on a second field while the first is being printed. All of the entered fields need not be saved on the disc for subsequent processing; a

regular customer's name and address can be stored in a separate record, with only his account number in the record to be processed. Conversely, the source data entry that is printed can include file data stored on the disc. Thus, the operator need key in only an account number, and the system can automatically produce the name and address on the printout. The following forms can be prepared in this way:

- Customer invoices.
- Purchase orders.
- Bills of lading.
- Contracts.
- Inventory listings.
- Tax statements.
- Payroll checks.
- Insurance policies.

Remote Batch Transmission. The 2300 can transmit data in attended or unattended mode. During any transmission period, entry, printing, and processing are suspended. The system resembles a remote batch terminal in that partially processed, compacted records can be transmitted in batches late at night when communication rates are lowest. The 2300, however, is not meant to compete directly with batch terminals in transmission procedures. Instead, MDS offers the 2400 System.

USER REACTIONS

A packing firm is very satisfied with 14 MDS 2300s used to estimate job costs. The units were chosen to replace IBM 3735s because the company was unhappy with the IBM printer. Compatibility with IBM's software and a fast printer with automatic tabbing and spacing were two criteria considered important when choosing the system. Besides rating Mohawk's service as excellent, this user reports that when there was a problem with heat sensitivity in the machines, Mohawk replaced the defective boards quickly.

A company that runs credit bureaus and collection agencies has encountered software problems with its 13 MDS 2300 units used for accounting and report functions. The 2300s were selected as replacements for the 3735s to increase speed and storage capacity. The firm is using an IBM B10 communications program, which breaks down during calls to its installations each night. Problems have ranged from installations not answering to inability to communicate after answer. This user feels the MDS 2300 software is barely compatible with IBM software. Despite the software difficulties, this firm plans to upgrade its main installation to an MDS 2409, which will be able to handle its growing business. This user says that maintenance in most cities has been prompt and well-handled.

A manufacturer of batteries uses the MDS 2300 to enter orders and confirmations from the field. After orders are entered during the day, they are sent to the central computer to be processed at night. Statistics and progress reports are then relayed back to the field before the offices open in the morning. The company is pleased with several features of the 2300: the interpretive-type programming which uses little core, the expanded disc module and tape cassette for auxiliary storage, and the CRT and keyboard. This user reports that the system runs very quietly. The only problems with software occurred because the system was ordered early in its development, and features had to be added as they became available.

SYSTEM DESIGN

The minimum 2300 System consists of a Model 2307 processor and 4K bytes of memory, together with a 230K-byte fixed-head disc (115K bytes of disc are reserved for system software), 9-inch (diagonal) CRT display, and keyboard. The CRT, processor, disc unit, and communication controller are housed together in a small console, while the keyboard and optional printer are mounted in an attached work table. Binary synchronous communication is usually included, although the system can operate as a freestanding, noncommunicating system. To this basic system can be added up to 691K bytes of disc storage, and one or two cartridge tape drives mounted in the same cabinet. An external computer-compatible tape drive and various line printers can also be added.

CRT. The CRT displays four lines of up to 32 characters each; it uses an upper- or lowercase alphanumeric character set. The display lines are dedicated to the following functions:

- Line 1 — Mode field and priority message field.
- Line 2 — Operator guidance prompting messages.
- Line 3 — Error messages.
- Line 4 — Display of operator-keyed information.

This type of single-line data display format permits fill-in-the-blanks formatting on a field-by-field basis. Prompting messages are generally standardized; they refer to restrictions on data entry into the current fields, to I/O devices, or to user-defined messages to the operator. Priority messages refer to system status conditions that require operator attention, such as CPU CALL or DISK FULL. The mode field refers to the type of keyboard operation and designates whether the keyboard is controlling the CRT or system printer. Typical modes are Enter Form, Playback, Local, and Request.

Keyboard. The MDS keyboard is identical to the 3735 keyboard (typewriter-style with added numeric pad), except that it does not have system indicators. However, such messages are displayed on the CRT.

Printers. The optional system printer is a 30-character-per-second friction-fed printer that prints a 96-character set (upper- and lowercase) on 6-part forms. Advancing of forms, positioning of the print wheel, and location of fields can all be under program control. Data entered previously or generated internally can be output along with data currently being keyed.

The system printer is set to print at six lines per inch like a normal office typewriter; the reusable nylon print ribbon comes in a cartridge so that it can be easily changed by the operator. Print wheels can be ordered in a variety of international character sets (including French, German, Scandinavian, United Kingdom, Japanese, and Katakana) as well as in U.S. versions. The print wheels can be changed by an operator. A forms tractor option facilitates the feeding of pin-fed forms.

The Model 1310 printer for the 2300 is not, strictly speaking, a line printer; it is a 100-character-per-second dot matrix serial printer. This freestanding unit, which is also controlled by the system processor, is used primarily to print reports received from the central site.

The 1310 printer handles continuous pin-fed forms, 4 to 14.875 inches wide. Vertical format control is exerted by a paper tape VFU loop in conjunction with three modes determined by switch setting: Edit, Line-Edit, and List.

The Model 2432 line printer is a 300-line-per-minute drum printer with 132 print positions and a 64-character set. It requires the 4110 printer controller. The following European character sets are available: Denmark/Norway, Sweden/Finland, German, and ICL.

The Model 2444 chain printer is a 380-line-per-minute chain printer with a 48-character set. Standard print width is 132 columns. This printer requires the 2101 printer controller, and is supported only by the RJE system software.

The Model 2445 chain printer is a 760-line-per-minute chain printer with a 48-character set. Standard print width is 132 columns. This printer requires the 2101 printer controller, and is supported only by the RJE system software.

Magnetic Tape Storage. Two types of magnetic tape units are available. The Model 2330 4-track cartridge tape drive uses 3M magnetic tape data cartridges. Two 9-track computer tape drives are available; the Model 2481 records 800 bits per inch using NRZI recording, and the Model 2482 records 1,600 bits per inch using the PE recording technique. The system can attach two cartridge drives and one computer tape drive (½ inch computer compatible). It requires the 3101 control unit.

Optional Disc Storage. Model 7101 provides an additional 230K bytes of user disc storage, and Model 7102 provides an additional 460K bytes of user disc storage.

DATA COMMUNICATIONS

The following communications features are available for the MDS 2300:

- Synchronous communications controller — Feature 2200 provides bi-synchronous communications at transmission rates of up to 9,600 bps. This feature is field-installable.
- Synchronous clock — Feature 2201 allows the 2300 to operate with non-synchronous (unclocked) modems. This feature is field-installable and requires Feature 2200 as a prerequisite.
- Alternate modem select — Feature 2203 provides support for two modems. The modem to be used is selected via a switch on the operator's console. This feature is field-installable and requires Feature 2200 as a prerequisite.
- DPS Multi-Point/Inquiry — Feature 2207 is required for communicating with a host CPU in an on-line, multi-point environment over leased lines. This feature is field-installable.

There are three disc-resident communication programs — 2780, 3780, and REMOTE COPY — available for the MDS 2300. All programs provide bi-sync communications at up to 9,600 bps. Data transfers are performed in the half-duplex mode using EBCDIC code.

SOFTWARE

Software for the MDS 2300 is provided in the form of a Terminal Control Program (TCP) which resides on the write-protected version of the 2300 disc. The TCP controls the functions of the user-written Form Description Programs (FDP), as well as the utility programs for peripheral devices.

Also available is software which allows programs for the 2300 to be written, debugged, and compiled on MDS 2400 peripheral processor systems and then transmitted to the 2300.

Applications Packages

The following packages, which are available for the MDS 2300, are designed to be general packages for all segments of the marketplace.

- Invoicing/Order Writing.
- Distribution/Inventory Control.
- Procurement/Purchasing.
- Cost Estimating.
- Freight Billing/Tracing Manifests.
- Hospital Admissions/Billing.
- Petroleum/Bulk Plant Distribution.
- Policy Writing/Claims Adjustment.

MAINTENANCE

MDS maintains the 2300 Series through its network of sales and service centers in the United States, Canada, Europe, Latin America, Asia, Africa, and Oceania. In the United States alone, MDS employs 555 customer engineers in its 120 branch offices.

MDS offers a variety of maintenance contracts for leased systems, including 24-hour, 7-day-per-week, on-call emergency maintenance. Emergency calls are usually answered within 2 hours. Preventive maintenance schedules depend on how much the terminal system is used, but the average is once every 3 months.

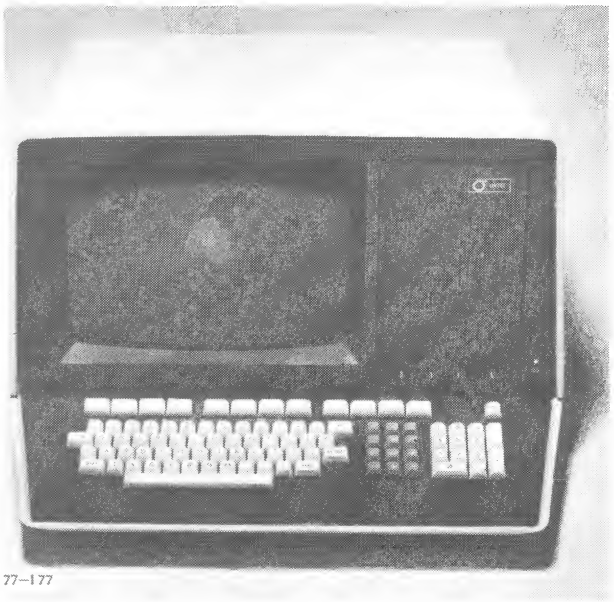
Major spare parts are stored in regional centers and at each branch office. Regional centers in the United States are located in Atlanta, Philadelphia, New York, Chicago, Houston, and Los Angeles.

PRICE DATA

Model/Feature No.	Description	Monthly Rental (Not Incl Maint.) $	Purchase Price (Not Incl Maint.) $	Monthly Maint. $
2307	Terminal, 4K bytes memory, 230K-byte disc, keyboard, and CRT	221	10,400	65
7101	Additional 230K bytes disc storage	30	1,400	5.50
7102	Additional 460K bytes disc storage	60	2,800	11
	PERIPHERALS			
2340	30-cps Printer	108	4,600	18.50
1310	100-cps Dot Matrix Printer	143	7,400	62.50
2343	300-lpm Printer	324	15,800	112
2444	380-lpm Chain Printer	385	16,650	139.50
2445	760-lpm Chain Printer	616	25,900	169.50
2330	Cartridge Tape Drive	22	1,000	5.50
2352	Card Reader (400 cpm)	85	3,600	31
2481	9-track, 800-bpi Magnetic Tape Drive	171	8,000	55
2482	9-track, 1,600-bpi Magnetic Tape Drive	242	11,000	67
3101	Controller/Cartridge Tape Drive	20	1,000	5.50
4101	Controller/2340 Char. Printer	—	—	—
4110	Controller/1310, 2343 Printers	8	400	2
5101	Controller/Card Reader	8	400	2
2101	Selector Channel (required for 2444/2445 or 2481/2482	20	1,000	5.50
	DATA COMMUNICATIONS			
2200	Sync Communications Controller	15	1,000	5.50
2202	Sync Clock	8	320	2
2203	Alternate Modem Select	9	400	1
2204	Voice/Data Switch	2	80	—
2205	Select/Standby Switch	2	80	—
2206	Data-Rate Select	2	80	—
2207	Multi-point/Inquiry Mode	—	—	—

ONTEL CORP.

OP-1 Programmable Terminal



77-177

OVERVIEW

The Ontel OP-1 Programmable Terminal is a multiple microprocessor intelligent terminal aimed at the OEM market. With this type of marketing orientation, the company stresses high quality engineering, flexible design, low cost, high level languages and software.

A large display, terminal keyboard, processor logic, memory, and five slots for peripheral controllers are all combined into a stand-alone, desk-top unit. The OP-1 can be programmed for on-line or off-line use in synchronous or asynchronous modes, or in emulation of a variety of other products. Ontel supplies standard interfaces for diskette, disk, and printer subsystems, as well as low- and high-speed communications. The company also provides peripheral devices, but encourages large volume buyers to obtain peripherals from the original manufacturer for obvious service and cost reasons. Software support includes an assembler, editor, and various utilities for I/O devices.

The OP-1's terminal has three separate microprocessors: the first dedicated to CPU functions, the second to I/O handling, and the third for display control. The three independent units let the OP-1 perform simultaneous computation, input/output operations and display control.

The company has announced a master/slave clustered-terminal configuration. The new multiprocessor adapter option will allow the system to be tied into a complex of up to 256 Ontel systems with a separate parallel interprocessor bus. Presently four OP-1 systems can be connected to share a common disk data base, but the new system will allow several data bases to be interconnected. Technical specifications for the system are in Table 1.

PERFORMANCE AND COMPETITIVE POSITION

Ontel has been in the terminal business for eight years, formerly under the name of Sugarman Laboratories. The OP-1 was first delivered in October 1974, and the company estimates that to date more than 2,500 systems have been delivered.

The low cost of the Ontel OP-1 makes the system competitive not only with other intelligent terminals but also with firmware-controlled and hardwired displays. The OP-1 offers many highly developed software packages and also has the flexibility of being user programmable for any special application.

USER REACTIONS

A New England bank, which has had 22 OP-1s for about a month, uses the terminals for inquiry purposes to its central information file; specifically to input mortgage and installment loan transactions. Before deciding on the Ontel units, the company considered other terminals such as the Burroughs TD800 Series, but selected the OP-1 because it was low in cost and could interface with the user's Scope Data printer. A spokesman for the company said that what he liked best about the OP-1 terminal was its screen size (24 lines with 80 characters per line), its clear display characters, and its reliability. He added that they have had a 99+% uptime average with the Ontel terminals.

A midwestern computer center has used the OP-1 terminals in an on-line system for more than three years. Most of the approximately 110 terminals are located in the data center with some stationed in other parts of the country. The terminals are used to emulate Burroughs and Teletype terminals, as remote printing stations and for general administrative functions. One of the main reasons for select-

HEADQUARTERS

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250 Crossways Park Dr
Woodbury NY 11797
(516) 364-2121

Table 1. Ontel OP-1: Specifications

IDENTITY	ONTEL OP-1
PROCESSOR	
Type	Microprogrammed
Configurations	Stand-alone or cluster
Mode	On-line, off-line
Main Memory, Bytes	4K-64K
Word Length, Bits	8
Cycle Time (usec)	2 cpu, 1 memory
No. of I/O Channels	4 DMA, 1 programmed I/O
Max Devices/Channel	1 each DMA, 2 on PIO
AUXILIARY	
Medium	Cartridge disk
Storage Capacity (bytes)	2.5M or 10M
Other Features	Multiterminal disk sharing
SOFTWARE	
Language Supported	Assembly, BASIC, COBOL type
Terminal Emulation	Programmable
Utility Routines	Editor, diagnostics
KEYBOARD ENTRY	
Console Layout	Teletypewriter
Code Generated	ASCII
DISPLAY UNIT	
Configuration	Stand-alone
Screen Capacity (char)	1,600 or 1,920
Line x Char/Line	20 or 24x80
Displayable Char Set	96 ASCII or 256 special
Editing Facilities	Programmable
PAGE PRINTER	
Platen/Print Mechanism	Dot matrix, impact
Line Length, Char	80 or 132
Rated Print Speeds (cps)	To 200 lpm
Printable Char Set	96 ASCII
Other Features	
PERIPHERALS	
Card Reader	No
Line Printer	Yes
Magnetic Tape	Cartridge
Diskette	Floppy Disk
LINE TRANSMISSION	
Interface	RS232C/2 Wire Direct/20 Mil Loop/Bal Line/Mil 188
Data Rate (bps)	Async; to 9,200
w/Synchronization	Sync: to 50K
Operating Mode	Full- or half-duplex
Line Code	ASCII; other programmable
Error Control	LRC; Modulo 8, programmable
COMPATIBILITY	
Computer System	Programmable
Bell Data Set	Programmable

ing the Ontel unit was that it was one of the first user-programmable microprocessor-based terminals, and was less expensive than PROM and ROM-based terminals. They wanted to take advantage of the new technology. And they felt that the use of software was a hedge against obsolescence. A spokesman said the terminal's architecture was what he liked best about the OP-1. He also said that this terminal had the best blend of keyboard functions for their needs. The terminal's flexibility in peripherals attachments and its user programmability were other important features the spokesman noted. What he liked least about the OP-1 terminal was the large physical size needed to encase its 14-inch screen. Reliability has been a strong point with these terminals. This spokesman noted that there were only two outages per year per terminal.

CONFIGURATION GUIDE

The Ontel OP-1 mainframe contains display, keyboard, all terminal logic, memory, and room for five I/O controllers (one asynchronous adapter plus four assorted DMA-type controllers) in a simple desk-top unit. The terminal logic has three microprocessors dedicated respectively to CPU functions, I/O functions, and display functions. Also included is a 256- or 512-byte bootstrap loader. Figure 1 shows a functional block diagram of the system.

Controllers for the disks, diskette, printers, asynchronous, bisynchronous, and synchronous communications interfaces can be attached to any or all of the DMA ports controlled by the I/O Microprocessor. The CPU, however, directly controls the low-speed asynchronous communications adapter.

The disk subsystem has a disk controller and file controller. The latter has four connectors, so up to four OP-1s can be connected to one disk data base. Each OP-1 must have a disk controller.

The multiprocessor adapter is the link into a common interconnection with its own parallel bus that can link up to 256 Ontel OP-1 terminals. Any terminal can declare itself the master of the cluster.

MAINFRAME

Central Processor and Memory

The microprocessor used for CPU functions is an eight-bit Intel 8080 with a two microsecond cycle time and an eight-level interrupt capability. The instruction set includes: arithmetic, logic, load, store, jump, call, return, rotate, increment, and decrement. Programs can be loaded from any local or remote source.

Random access memory size ranges from 4,096 to 65,536 bytes expanded in 4,096-byte increments. Memory can be used for program storage, display, or I/O functions.

The CPU (rather than the I/O microprocessor) directly manages the keyboard and an asynchronous I/O adapter. The adapter and keyboard are connected directly to the CPU I/O bus. The keyboard contains 93 keys set in four pads (ASCII set, control pad, numeric pad, function pad), four status lights, a programmable audible tone, automatic repeat, and 2-Key rollover. N-Key rollover is optional.

The asynchronous and synchronous communications controllers are handled by the I/O microprocessor.

Display and Display Control

The display unit is a 14-inch CRT that can display 20 or 24 lines of 80 characters each (1,600 or 1,920-character capacity). Character size is .21 by .09 in using 9 by 7 or 13/11 dot matrix. The displayable set can be as great as 256

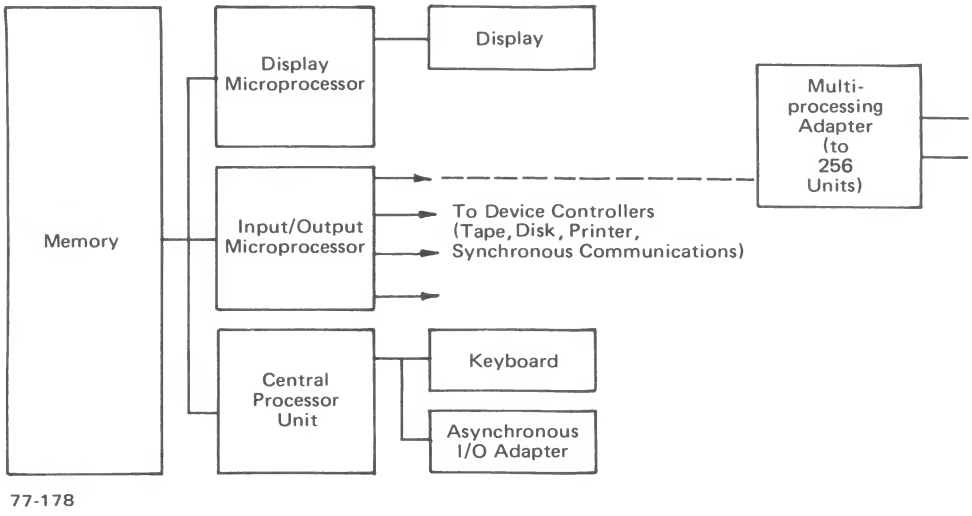


Figure 1. Block Diagram of Ontel OP-1

characters which are programmable. Characters can be displayed black on white or white on black. The raster consists of 262 or 312 non-interfaced lines with a refresh of 60 frames per second.

Program-controlled functions include the size of the page, cursor location, erase and edit, blink characters, blink cursor, roll and scroll, reverse screen, reverse characters, half intensity, and window location. The display is a movable window in memory. Note that total memory can be assigned as a display buffer.

Input/Output Control

The I/O microprocessor, which is field-installable, manages data transfers between memory and the DMA device controllers housed in the mainframe. All data transfers are performed on a cycle steal basis. All microprocessors can access main memory, but only one can access memory at a given time because all three microprocessors share a single port to memory.

Up to four OP-1 systems can be interconnected in such a way as to share a single disk data base, with access priority determined by the disk file controller. File update protection comes from an update lockout feature, since all four processors can issue I/O commands regardless of file usage by the others.

PERIPHERALS

Printer

The printer is a fast parallel dot matrix printer that can achieve 60-150 or 60-200 lines per minute depending on the model. The 64 ASCII character set is printed at either 80 or 132 characters per line.

Tape Cartridge Subsystem

The tape cartridge subsystem is composed of up to four 3M cartridge drives. One, two, or four tracks can be recorded on each drive, with a 2.8M byte cartridge capacity in a 4-track system. Error checking includes a longitudinal redundancy check and a Modulo 8-bit count.

Disk

There are two disk subsystems, both using cartridge disk drives and both allowing up to four drives per controller. One subsystem uses 2.5M byte disks, with a subsystem capacity of 25M bytes and an average access of 20 milliseconds. The other uses 10M byte disks with a subsystem capacity of 40M bytes and an average access of 12.5 milliseconds. Data is organized in sectors of 256 (the 2.5M disk) or 512 (the 10M disk) bytes. Read/write records can be of any length up to 6,144 bytes in a single I/O operation. Disk subsystems can connect to any or all four I/O ports, so maximum system capacity is 160M bytes.

Diskette

The diskette subsystem is composed of up to four floppy diskette drives, each capable of 300K bytes of storage for a total of 1.2M bytes. A soon to be released development will raise this capacity to 4.8M bytes, making one dual diskette drive rival the storage capacity of a hard disk system.

COMMUNICATIONS

The asynchronous communications adapter is handled by the CPU microprocessor, and the I/O microprocessor handles the synchronous and asynchronous communications adapter.

The asynchronous adapter is an EIA RS232 interface handling rates of 110 to 9,600 bps. Data transmission can occur in character or block mode, full- or half-duplex mode. Communications parameters, such as parity, data length, number of stop bits, transmission rate, and so on, are all program-controlled.

The synchronous communications controller is an EIA RS232 compatible interface handling rates up to 50K bps in direct point-to-point or multipoint transmissions. The input/output discipline is programmable, including synchronization coding, attention code, and parity (odd or none).

The asynchronous communications controller has multiple interface configurations and can handle rates up to 19,200 bps. Data transmission can occur in character or block mode, full- or half-duplex mode. Communications parameters, such as parity, data length, number of stop bits, transmission rate, and so on, are all program-controlled.

SOFTWARE

Software support for the OP-1 is extensive. While designed for OEM manufacturers who usually write their own software, there are many utilities available including: data entry, editor, diagnostics, and others.

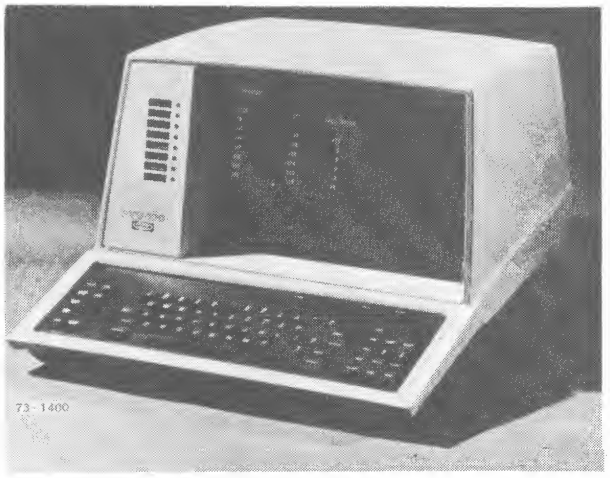
Also, assembler and higher level languages are available. These higher level languages are BASIC and a COBOL-type language called SACBOL.

A complete word processing program also has been developed for use in office environments.

PRICES

A basic system, including all three microprocessors, display, keyboard, and 4K words of memory, costs $2,285 in OEM quantities of 100 or more. Ontel does not provide for leasing or maintenance.

RAYTHEON DATA SYSTEMS
PTS-100



OVERVIEW

The Raytheon PTS-100 is a minicomputer-based intelligent terminal system designed as a plug-to-plug compatible substitute for IBM's 3270 and 2260 display systems, as well as a replacement system for IBM's 2948/2915 display terminals used in the PARS/IPARS airline reservations system. The PTS-100 has also grown to be a competitive intelligent terminal in its own right; it is available in three basic models and in stand-alone or clustered configurations.

The models of the PTS-100 differ in memory capacity and in the number of terminals and peripherals they support. The basic PTS-100 is configured with 8K to 16K bytes of MOS semiconductor memory, which is expandable to 64K bytes in 8K- or 16K-byte increments. Also included are I/O display/keyboard interfaces and a power supply, low-speed multiplexor channels, a high-speed input/output bus, and a 15-inch diagonal CRT unit and associated keyboard. A maximum PTS-100 configuration can support thirty-two 480- or 960-character displays or twenty-four 1,920-character displays.

Software for the PTS-100 includes an Input/Output Control System (IOCS); an assembler which permits the use of macros; and utilities for file update, debug, and disc file. PARS/IPARS, 2260/2848 Emulator, and IBM 3270 Enhanced Emulator packages are also available. The 3270 Enhanced Emulator package is the newest announcement for the PTS-100. It is designed to reduce the amount of host intervention in the emulator's operation. Local print, local format storage, variable device addressing, and card reader support allow offloading of the host system. See Table 1 for PTS-100 system specifications.

Since the 1960s, Raytheon has been marketing hardwired CRTs for use in the airline reservations systems market (PARS/IPARS). Raytheon has been successful in competing with the IBM and the Univac Uniscope terminals that are also aimed at this market, and boasts a large list of airline customers (American Airlines, Eastern Airlines, KLM, TWA, and Qantas). The PTS-100, first delivered in June 1972, has extended Raytheon's penetration beyond that of airline reservations systems, and has successfully entered the insurance market, brokerage houses, banks, and credit bureaus.

In September 1975, Raytheon introduced the PTS/1200 System for distributed processing applications. The PTS/1200, which is based on the PTS-100, has been designed to operate as a stand-alone system or a remote satellite processor communicating with an IBM System/360 or 370 in a batch mode. It offers the user a macro-based display-oriented language (MACROL) and a comprehensive set of utility programs.

Service is provided by Raytheon Data Systems both domestically and internationally. Domestically, there are 51 offices located in major U.S. cities and in geographic areas where there is a major work load.

COMPATIBILITY

The PTS-100 is compatible with the IBM System/360 or 370; it can attach directly to a System/360 or 370 byte multiplexor channel. Also, it can communicate with the 360 or 370 over a modem and communication line.

Other IBM compatibility is provided by software emulation packages. Packages are available to emulate the 2260/2248, 3270, and 2915/4505 (PARS) terminals.

Through the use of modem adapters, the PTS-100 is able to support commercially available data sets using either private or common carrier lines. Each adapter connects to 1 of the available multiplexor subchannels. They permit full- or half-duplex transmission at rates up to 9,600 bits per second (asynchronously or synchronously). The available model adapters all support full- or half-duplex synchronous operation. The electrical interface conforms to

HEADQUARTERS

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Table 1. Raytheon PTS-100: Specifications

Processor	
Main Memory (bytes)	8K-64K
Memory Type	MOS
Word Length (bits)	16
Cycle Time (μsec)	1.0
CRT Display	
Max No.	32
Screen Size (in.)	15 diagonal
Character Set	64 uppercase, 96 upper/lowercase
Keyboard	
No. of Keys	67, 69, 79, 81, 82, 89
Compatibility	
Computer Systems	IBM System/360, 370; Raytheon 704, 500
Terminal Emulation	IBM 2260/2848, IBM 3270, IBM 2915/2946, IBM 4505/2948, Univac U100
Bell Data Set	103E/F, 201A/B, 202C/D, 208, 2025
Line Transmission	
Line Facility	Leased and switched
Transmission Code	ASCII/EBCDIC
Data Rate (bps)	9,600
Synchronization	Async/sync
Interface	EIA RS232C
Error Control	CRC, LRC, VRC

EIA RS232C and CCITT recommendation V.24. The modem-supplied clock determines the actual data transmission rate.

PERFORMANCE AND COMPETITIVE POSITION

The PTS-100 competes mainly as a replacement and emulation terminal with intelligent capabilities. As a replacement system for IBM 2948/2915 display terminals in PARS/IPARS systems, the PTS-100's major competition, besides IBM, is the Incoterm SPD 10/20 and 10/25. In the IBM 3270 emulation market, the PTS-100 competes (in comparable configurations) with the Sycor 250, 340, and 350; the Datapoint 1100; Four-Phase System IV/40 and IV/70; and the Computer Optics CO77.

While the PTS-100 has been a tremendous success for Raytheon over the past several years, the introduction of the PTS/1200 System to meet the needs of the distributed processing market has taken away some of the PTS-100's competitive edge. For example, disc is no longer available with the larger configurations of the PTS-100. A user who needs disc storage as a part of his system's configuration must choose the PTS/1200. Consequently, the PTS/1200 System is better equipped to compete against the Four-Phase systems and clustered configurations of the Sycor and Datapoint terminals.

CONFIGURATION GUIDE

There are three basic models of the PTS-100. They are differentiated mainly by the number of terminals and the number of I/O channels they support. The models and their specifications are as follows:

- Model 1014 — 2 local displays; no remote displays; 5 low-speed half-duplex I/O channels; 3 high-speed I/O channels; and a maximum of 32K bytes of main memory.
- Model 1015 — 4 local displays; 16 remote displays; 8 low-speed half-duplex I/O channels; 3 high-speed I/O channels; and a maximum of 32K bytes of main memory.
- Model 1020 — 8 local displays; 36 remote displays; 24 low-speed half-duplex I/O channels; 10 high-speed I/O channels; and a maximum of 64K bytes of main memory.

The low-speed channels are for attaching I/O devices such as printers and card readers, which operate at up to 9,600 bps, and for attaching the PTS-100 to other systems. The high-speed channels are for devices that operate at speeds of up to 1 megabyte/second.

The actual number of high- and low-speed channels that can be used depends on the system configuration. Remote displays are driven by remote concentrators which may be located up to 4,000 feet from the processor; remote displays may be located up to 200 feet from the remote concentrator, for a total of 4,200 feet from the processor.

Expanded Configuration Guide

The PTS-100 is available in four versions: the Model 1014 Stand-Alone Display System, the Model 1015 Expanded Stand-Alone Display System, the Model 1015 Medium Cluster Display Station, and the Model 1020 Large Cluster Display System.

Model 1014 Stand-Alone Display System. The basic system includes a processor, 8K-byte memory, high-speed I/O bus, multiplexor channel with 4 subchannels, modem adapter, initial program load ROM, integral display adapter/monitor controller, 64-symbol set, and 1 display with 69-key keyboard cards. The screen and line sizes for the display adapter/monitor controller and modem adapter type are open to customer specification. The customer engineering console, a suitcase tester for use at the customer's site, is available as an option.

The 1014 has a maximum memory capacity of 16K bytes, and the display adapter/monitor controller can handle one 1,920-, two 960-, or two 480-character displays, which can be located up to 200 feet away.

Model 1015 Expanded Stand-Alone Display System. The Model 1015 stand-alone display is a 1014 with an expansion feature board, including configuration control switches, an alternate program load device address switch, interval timer, and initial program load ROM. The 1015 multiplexor channel has 8 subchannels.

In addition to the expansion features, the 1015 offers a watchdog timer option, customer engineering console,

channel interface controller, and remote program load option.

Model 1015 Medium Cluster Display System. The Model 1015 cluster configuration includes the components of the 1015 stand-alone system, except that the integral display adapter/monitor controller is replaced by 2 separate units: a display adapter with 8 channels, and a monitor controller located in the processor or in an optional remote concentrator. The separate units allow the display adapter to be located 4,000 feet away from the monitor controller, which can be 200 feet away from the displays.

Systems and software considerations limit the maximum number of monitor controllers per system to 4 (rather than the theoretically possible 8 which require 16K bytes of display refresh storage). Two monitor controllers can be mounted directly in the processor, and 4 displays can be driven from the processor. Any monitor controller not mounted in the processor is placed in the optional remote concentrator unit.

Standard power supply for the remote concentrator and the processor can drive 4 displays. A display expansion module, added to the remote concentrator, increases the capacity to 16 displays.

Program memory requirements determine the number of displays the system can handle. Up to four 1,920-, eight 960-, or sixteen 480-character displays can be attached to the configuration.

Model 1020 Large Cluster Display System. The 1020 is similar to the 1015, but it has more options and expansion capabilities.

A maximum of 4 display adapters per system allows the use of 32 monitor controllers (requiring 64K bytes of memory to refresh displays). Software requirements limit the number of monitor controllers to a maximum of about 24, 4 of which can be placed directly in the processor, thus 8 displays can be driven from the processor.

Processor options include the watchdog timer, remote program load, 2 additional multiplexor channels, computer interface channel, and disc. Memory is expandable in modules of 8K bytes to a maximum of 64K bytes. To increase the memory size beyond 32K bytes, or to add multiplexor channels, a memory expansion module must be added to the processor. The memory expansion module includes its own power supply.

Up to twenty-four 1,920-, forty-eight 960-, or ninety-six 480-character displays can be configured with the 1020 system. Four 1,920-, eight 960-, or eight 480-character displays can be attached directly to the processor.

MAINFRAME

The PTS-100 is comprised of: a processing unit which contains the processor, main memory, I/O and display/keyboard interfaces and a power supply, low-speed multiplexor channels, a high-speed input/output bus, and a 15-inch diagonal CRT unit and associated keyboard.

Display adapters refresh data stored in memory, multiplex the data received from the keyboards, and refresh the screens. Models 1014 and 1015 require one display adapter per 32K bytes of memory, and Model 1020 requires one display adapter per 16K bytes of memory.

Data which is transferred to and from displays/keyboards is processed by display drivers. The display drivers provide character generation, power, and sweep signals for the attached displays. Each display driver can attach two 1,920-character, four 960-character, or four 480-character displays and associated keyboards. Depending on whether the terminals are local or remote, the display drivers are located in the processing unit or the remote concentrators. The PTS-100 Model 1014 uses a combined display adapter/display driver. All other models use separate display adapters and display drivers.

Central Processor

The processor is a 16-bit general-purpose minicomputer with a 1-microsecond cycle time. The processor executes 29 singleword (16-bit) and doubleword (32-bit) instructions. Memory addressing is by word (16-bit) and byte (8-bit). There are four modes: absolute, dynamic page, indexed addressing, and single level indirect addressing. A high-speed I/O bus, 8-level hardware priority interrupt system, and an interval timer are included in the processing unit. Models 1014 and 1015 have a standard 8K-byte memory which is expandable to 32K bytes, and Model 1020 has a standard 16K-byte memory which is expandable to 64K bytes.

The initial program load can be from either a local or remote source. The local source device can be a cassette tape or card reader. A remote program load (RPL) is initiated from the host processor and transmitted by the communication facility. RPL permits central control by the remote processor.

Main Memory

Main memory consists of random access semiconductor MOS modules. Word size is 16 bits (2 bytes). Cycle time is one microsecond per word. Modules are available in increments of 8,192 bytes and 16,384 bytes to permit memory expansion up to 65,536 bytes.

Each memory module has 2 ports of entry, and each 8K-byte module operates independently of all others. Thus, the processor and the display can access different modules simultaneously.

I/O CONTROL

A high-speed, 16-bit wide, bidirectional I/O bus with 1 multiplexor channel is standard on all PTS-100 models. Up to 8 high-speed devices, such as discs and host processor

channel interfaces, can connect to the I/O bus in addition to the multiplexor channel, which can have 8 subchannels.

The I/O bus can support a second and third multiplexor channel with 4 to 8 subchannels in place of 1 or 2 of the high-speed devices.

At present, adapters are available to attach a line printer, serial printer, Teletype 33 (RO and ASR), magnetic tape cassette, card reader, and modems to the multiplexor channel. Devices require 1 multiplexor subchannel for half-duplex operation and 2 subchannels for full-duplex operation.

Display adapters connect to the memory bus and can access memory directly to refresh the displays included in the system. Keyboard input associated with the CRT display terminals is multiplexed in the display adapter into a dedicated subchannel of the multiplexor channel.

Display adapters connect to the display terminals via a monitor controller, which provides character and video generation for the display. The Models 1014 and 1015 use an integral display adapter/monitor controller which can support one 1,920-character display terminal or two 960- or 480-character displays. Distance between the display terminal and the adapter/controller can not exceed 200 feet.

The display adapter for Models 1015 and 1020 has 8 channels. Each channel can theoretically drive 1 monitor controller. Up to 4 (1015) or 8 (1020) displays can be driven from monitor controllers mounted inside the processor enclosure (for displays located within a distance of 200 feet). Monitor controllers can handle one or two 1,920-character displays, two 960-character displays, or four 480-character displays plus 4 keyboards and 4 indicator panels.

The power supply of the processor and the remote concentrator can drive 4 displays. A display expansion module can be added to increase the capacity of the processor (1020 only) to 8 displays and the remote concentrator to 16 displays. Multiple remote concentrators can be connected to a system.

The display adapter, attached to the memory bus, transmits refresh data serially (8 bits per character) via a monitor controller associated with from 1 to 4 displays. The Monitor Control Unit accepts this data, converts it to video form, and separates it for the appropriate unit.

All displays on a display adapter must have the same number of characters per line (40, 64, or 80) and lines per screen.

PERIPHERALS

Aside from its own CRT and keyboard, the PTS-100 supports both high- and low-speed peripherals.

CRT. Each CRT display is a self-contained unit with a 15-inch rectangular display area with a 60-cycle refresh rate. The standard 64-character set (uppercase only) is implemented by a 7 x 7 matrix. The optional upper/lowercase 96-character set uses a 7 x 9 matrix. Optional indicator panels and audible alarms are to be used under user program control to indicate system status, message transmission status, and terminal operating modes. A brightness control is standard. Dual intensity and blanked data fields are standard.

Three detachable keyboards are available: the standard 67/82-key; the 69/81-key 3270 emulator; and the 89-key 4505 emulator for PARS/IPARS applications. All keyboards include keys for alphanumeric and symbol entry, text editing, cursor control, and system functions. All key functions except SHIFT, REPEAT, and SHIFT LOCK are interpreted and acted upon by the software. An "n key rollover" allows, without data loss, multiple key depressions.

CRT and keyboard specifics are detailed in Tables 2 and 3.

Magnetic Tape Cassettes. The Model 3601 magnetic tape unit provides 300-foot tape cassettes. Record length is variable with a minimum of 60 bytes/record. Fifteen hundred records at 128 bytes per record for a total of 118K bytes, or 367K bytes for records of 10,672 bytes are examples of the cassette storage capability. Recording density is 800 bits per inch, with read-after-write validity checking using a 16-bit cyclic redundancy check (CRC) in each record. Cassettes can be used to store programs, to capture local data, and to store pre-established screen formats. A cassette adapter controls up to 4 cassettes.

Table 2. PTS-100 CRT Specifications

Dimensions (in.)	13.5 high x 18 wide x 25.5 deep
Input Power	±35 vdc at 0.4 amperes (provided from the remote concentrator processing unit)
Max Cable Length (ft) (data display to remote concentrator)	100
Screen (in.)	Horizontally mounted rectangular CRT, 11 wide x 8½ high (15 diagonal)
Viewing Area (in.)	10 wide x 7 high
Screen Formats	40 chars/line; 12, 24 lines 80 chars/line; 12, 24 lines 64 chars/line; 15, 16, 30 lines (uppercase only)
Displayable Character Formats (char)	480, 960, 1,024, 1,920
Refresh Rate (Hz)	60
Character Set	64 uppercase chars and symbols (64 chars/line, or 96) upper/lowercase chars and symbols (40, 80 chars/line)
Character Generation	Enhanced dot matrix 7 x 7 uppercase 7 x 9 upper/lowercase
Character Size (in.)	0.11 wide x 0.14 high (64 or 80 chars/line), or 0.15 wide x 0.17 high (40 chars/line)
Phosphor	P31 green

Table 3. Raytheon PTS-100: Low-Speed Peripherals

Peripheral Device	Performance Characteristics	Comments
Teletypes		
3402	Receive only TTY; 72 cols; 63-char ASCII set; 10 cps; full- or half-duplex operation	Attaches to mux channel via special adapter.
3404	TTY ASR; 72 cols; 63-char ASCII set; 10 cps; full- or half-duplex operation	Attaches to mux channel via special adapter.
CRT		
4101	480, 960, 1,920 char; 40, 64, 80 chars/line; 15-inch display; 60-Hz refresh rate; opt 8-light indicator panel, audible alarm and keylock	7 x 7 matrix; 64-char set; 7 x 9 matrix; 96-char set.
Keyboards (detachable)		
6101-01	Standard 67-key keyboard; 110 programmable functions; 52 keys with 95 functions for char entry; 5 keys with 5 functions for system control; 10 keys with 10 functions for editing and cursor control	Attaches to mux channel via monitor controller.
6102-01	82-key keyboard; 125 programmable functions; 52 keys with 95 functions for char entry; 5 keys with 5 functions for system control; 15 keys with 15 functions for a numeric pad and cursor control; 10 keys with 10 functions for editing and cursor control	Editing/cursor control keys can be replaced with numeric keypack; custom function keys can be programmed for editing and cursor control; attaches to mux channel via monitor controller.
6102-02	PARS/IPARS airline reservation keyboard; 82 keys	Attaches to mux channel via monitor controller.
6103-01	Similar to IBM 3270 data entry keyboard — 69 keys	Attaches to mux channel via monitor controller.
6103-02	Similar to IBM 3270 typewriter ASCII-A keyboard — 69 keys	Attaches to mux channel via monitor controller.
6103-04	Similar to IBM 3270 typewriter EBCDIC keyboard — 69 keys	Attaches to mux channel via monitor controller.
6104-02	Similar to IBM 3270 typewriter ASCII-A keyboard — 81 keys	Attaches to mux channel via monitor controller.
6104-04	Similar to IBM 3270 typewriter EBCDIC keyboard — 81 keys	Attaches to mux channel via monitor controller.
6106-01	Similar to IBM 4505 for PARS/IPARS applications — 89 keys	Attaches to mux channel via monitor controller.
6106-11	Same as 6106-01 except includes 6-light indicator panel	Attaches to mux channel via monitor controller.
Card Reader		
3201	300 cpm; 600-card hopper; 80-col cards; Hollerith or binary coding	Attaches to mux channel via simplex adapter.
Serial Printers		
3401	Receive only; 30 cps; 80 cols; 64-char ASCII set; original and 6 copies	Attaches to mux channel via simplex adapter.
3405	Receive only; 15 cps; 80 cols; 64-char ASCII set; original and 2 copies	Attaches to mux channel via simplex adapter.
3406	Receive only; 100 cps; 80 cols or 132 cols; 64-char ASCII set; original and 4 copies	Attaches to mux channel via simplex adapter.
3407	Receive only; 30 cps; 80 cols; 64-char ASCII set; original and 2 copies	Attaches to mux channel via simplex adapter.
3412	Receive only; 165 cps; 132 cols; 96-char ASCII set; original and 4 copies	Attaches to mux channel via simplex adapter.
Line Printers		
3301	Receive only; 300/lpm; 132 cols; 64-char ASCII set; original and 5 copies	Attaches to mux channel via simplex adapter.

which can be located 30 feet away. The adapter interfaces to a multiplexor subchannel. See Table 4 for magnetic tape specifications.

Card Reader. The Model 3201 reads 300 cards per minute, and has a 600-card hopper capacity. The reader handles 80-column cards with Hollerith or binary coding. The 3201 attaches to a multiplexor subchannel via an adapter. The reader can be located up to 30 feet from the adapter.

Serial Printer. Model 3406 is a receive-only printer that operates at 100 characters per second printing an 80-column or 132-column line (switch-selectable). The 3406 attaches to a PTS-100 subchannel via an adapter. The serial printer can be located up to 4,000 feet from the processor.

Line Printer. Model 3301 prints at 300 lines per minute and produces an original plus five copies. It offers a full 64-character set and a 132-column format. A 12-channel vertical format utilizes IBM-compatible carriage tabs. The 3301 printer attaches to a PTS-100 multiplexor channel via an adapter. The printer can be located up to 50 feet from the processor.

Teletypewriters. Two teletypes are available: Models 3402 and 3404. They are receive-only (RO) and automatic

Table 4. Raytheon PTS-100: Mass Storage Devices

Peripheral	Characteristics	Comments
Magnetic Tape		
3601 Cassette	300 feet; 800 bpi; read-after-write; CRC error check	Requires cassette adapter which controls up to 4 cassettes, only 1 may be used at a time; adapter interfaces to mux channel.

send/receive (ASR) versions of the Model 33 Teletype. They print 72 characters per line using a 63-character ASCII set, and they attach to the processor via a multiplexor subchannel. A special adapter is required to interface the Teletype to the PTS-100 multiplexor subchannel. This adapter permits full- or half-duplex operation at 10 characters per second and can be located up to 4,000 feet from the Teletype. It is supplied free with PTS-100 Teletypes or at extra cost if the customer's own Teletypes are used. Table 3 lists the specifications for the low-speed peripherals.

DATA COMMUNICATIONS

PTS-100 supports communications with a host processor in the local mode. Second, because of its possible role as a message switcher or clustered terminal controller, it supports communications with terminals via modem adapters. See Table 5 for a listing of PTS-100 Modem Adapters.

A Channel Interface Controller provides the interface between the PTS-100 I/O bus and a host IBM System/360 or 370 byte multiplexor channel. The Channel Interface Controller requires 1 high-speed channel, and it can only be used on Model 1020.

SOFTWARE

The PTS-100 provides software to handle both teleprocessing and batch applications. The following programs are available.

- IOCS Monitor.
- Assembler.
- Utilities.
- Applications.

IOCS Monitor

The Input/Output Control System (IOCS) monitor consists of 2 components: the I/O Control Nucleus and the Physical I/O Handler. The I/O Control Nucleus interfaces programs to the I/O Handler, which issues I/O commands to the peripherals and receives and initiates interrupts from the system devices.

The I/O Control Nucleus is composed of 3 groups of routines. The Level Service Routine handles interrupts from I/O devices and object program calls; it restores interrupt levels after interrupts from other levels have been serviced. The Monitor Service Call Routine performs the required processing to open, close, and initialize devices; to perform I/O operations; and to exit from the system when program processing is completed. An optional Monitor Log Service Routine produces 32-character messages on the System Log device.

The I/O Handler provides the device-specific hardware/software interface, services I/O interrupts, controls data transfers, and initiates appropriate I/O actions. The routine detects hardware errors, and either reports them to the executing object program or performs corrective action. Device Driver and Device Service Routines are included in the device handler for a PTS-100 configuration.

Assembler

The PTS-100 assembler is a symbolic machine-oriented language. The symbolic instructions are translated into machine instructions and addresses. It includes 29 machine instructions and 20 pseudo operations. Pseudo

Table 5. Raytheon PTS-100: Modem Adapters

Peripheral	Characteristics	Comments
Modem Adapters		
2331	6-level, 6-unit code, CRC error code	Modem supplied clock.
2333	10-level, 8-unit code, VRC/LRC error code	Modem supplied clock.
2334-01	8-level, 8-unit code, VRC/LRC error code; bisync; ASCII	Modem supplied clock.
2334-02	8-level, 8-unit code, CRC error code; bisync; EBCDIC	Modem supplied clock.
2341	10-level, 8-unit code, VRC/LRC error code; async	Adapter supplied clock.

operations direct the assembler to generate constants and to establish data areas. Object code can be absolute or relocatable.

The assembler permits the use of macros. These macros can be either supplied by Raytheon or created by the programmer and stored in the macro library for future use. Raytheon-supplied macros relate the object program to facilities of the PTS monitor.

The assembler has an optimization phase, which determines whether an instruction should be assembled as a 16- or 32-bit instruction, to guarantee the optimum use of program memory.

The PTS-100 assembler is available in 3 versions: the PTS-100 Native Assembler, the Raytheon 704 Cross Assembler, and the IBM 360/370 Cross Assembler. All programs run on the PTS-100 must be assembled under the PTS assembler. The assembler processing consists of 5 phases. Phase 0 determines and sets up output requirements for the program and calls the next phase. Phase 1 processes macro calls in source programs or the System Generator Program. Phase 2 analyzes the source statements and preprocesses the program assembly. Phase 3 optimizes core storage requirements of object programs. Phase 4 completes the assembly, generates any required listings, and produces the final object program code.

The assembler requires 16K bytes of memory.

Utilities

There are 6 basic utilities supplied with the PTS-100 Series.

- Loader.
- File Update.
- Debug.
- System Generator.
- Peripheral Dump.
- Memory Dump.

Loader. A Piggyback Loader and an Absolute/Relocating Loader are supplied with the PTS-100. The Piggyback Loader loads the Absolute Relocating Loader after being bootstrapped from the console. The Absolute/Relocating Loader must load all programs assembled by the PTS-100 assembler. The loader calculates effective addresses of object program instructions, sets up storage areas, loads literal values and address constants, relocates relocatable programs, establishes linkages between multiple program segments, terminates itself when the loading process is complete, and activates the loaded program.

File Update. The File Update Program can be used to create a master file of object or source programs, and to maintain and update the master file. It can insert 1 or more programs in the master file; correct programs by changing their names; delete, replace, or insert data; and create a file directory of the current master file. Programs can be replaced, deleted, or output onto selected storage media.

Debug. The Debug Program is interactive for object program checkout. The Debug Program has the following facilities: add or subtract hexadecimal constants, dump signal or successive memory locations, search memory for specific full word values, masked search on values less than 16 bits in length, and alter signal memory location content.

System Generator. The System Generator (SYSGEN) Program specifically tailors a PTS-100 IOCS monitor to meet unique application requirements. The system specifications are input to the SYSGEN program, and a series of macro calls to the generalized IOCS monitor is generated. The assembler processes the SYSGEN macro file against the System Macro Library file to produce the tailored IOCS monitor.

Peripheral Dump. This utility can produce, in either ASCII code or hexadecimal notation, a listing of data files from cassette tapes, punched paper tape files, or punched card files. Disc dumps are handled by a separate program.

Memory Dump. The Memory Dump transfers the contents of any contiguous main memory locations to any sequential storage device that accepts variable length output records. Two versions are available: the first produces hard copy on a character printing device; the second dumps to a magnetic tape cassette or paper tape punch device. Dump parameters are input from a keyboard device.

Application Packages

2260/2848 Emulator. The 2260/2848 Emulator makes the PTS-100 fully compatible with the IBM 360/370 system. A nondestructive cursor, tab, erase EOS, and erase EOL are standard features in the package.

PARS/IPARS. This package is designed to be used by customers having the IBM PARS/IPARS reservation system, departure control, or other systems using the IBM 1006 line control discipline. The system is designed to replace the IBM 2946 or IBM 2948 subsystems.

3270 Enhanced Emulator. This package uses the PTS-100 as a plug-to-plug compatible substitute for the IBM 3270 display. Raytheon has added the following enhancements to the package which are unavailable with the predecessor package or the IBM 3270 itself.

- Variable device addressing.
- Multiple keyboard support.
- User exits.
- Local print.
- Local format storage. (formats must be compiled and loaded into PTS-100 main memory from the host)
- Card reader support.

In all other respects, the system performs and emulates *all* of the functions of the IBM 3270 display subsystem.

The PTS-100 local IBM 3270 emulator will operate with the byte/block multiplexor channel or the selector channel

of the IBM System/360 or 370. The local 3270 emulator will run under OS-BTAM, DOS-BTAM, OS-TCAM, VS, or VM. The PTS-100 remote IBM 3270 emulator communicates with a host mainframe using a subset of BSC Multipoint Data Link line discipline.

MAINTENANCE

On-site maintenance is a plus for Raytheon. Service is provided by the Raytheon Service Organization, which consists of about 5,000 people. Of these, about 300 are actually involved in computer service. They work out of 26 domestic offices, with an additional 50 offices worldwide. Maintenance is included in monthly rental and purchase prices. Purchased systems carry a 90-day warranty on parts and labor.

PRICE DATA

Listed below are prices for typical PTS-100 configurations. As part of standard policy, Raytheon does not provide detailed pricing information for its products. The prices provided by Raytheon are said to include everything needed (sufficient memory size for 3270 emulation, and cassette for program load) for a complete PTS-100 System.

Description	Monthly Rental 1-Yr Lease (Incl Maint.) $	Purchase Price (Incl Maint.) $
8 Remote 480-character Displays	867	26,800
16 Remote 480-Character Displays	1,349	41,400
8 Remote 960-Character Displays	867	26,800
16 Remote 960-Character Displays	1,387	42,000
8 Remote 1,920-Character Displays	960	29,500
16 Remote 1,920-Character Displays	1,778	52,800
PERIPHERALS		
3406 100-cps Printer	150	3,200
3412 165-cps Printer	215	5,950
3301 300-lpm Printer	495	12,200
3201 300-cpm Card Reader	165	4,050
3407 30-cps Printer	120	2,500
3405 15-cps Printer	99	2,050
3401 30-cps Printer	160	3,800

SYCOR INC.

250 Series Intelligent Display Systems

OVERVIEW

The Sycor 250 Series are stand-alone, single-station and cluster terminal systems marketed by Sycor as plug-compatible replacements for the IBM 3270 Information Display Station. As fully compatible 3270 replacement systems, the Sycor 250 Series can be configured in the same ways as remote 3270 systems, including mixtures of on-line terminals, on-line printers, and terminals with light-pen options. The 250 does not, however, offer an equivalent of the IBM 3270 local cluster configuration (the 3272 control unit), which permits direct channel attachment to an IBM System/360 or 370 computer.

Like the IBM systems they replace, Sycor terminals use 480- and 1,920-character displays. As a security option, a magnetic striped badge reader can be added so that the terminal can be used only by persons presenting authorized identification. A security lock option is available for the same purpose.

The Sycor terminals have a number of features unavailable with the IBM terminals. Printers are offered in three speeds, 66,120, and 180 characters per second, as opposed to 40, 66, and 125 characters per second for the IBM 3270 terminal. Unbuffered versions of the Sycor printers can attach directly to the cluster CRT terminals, allowing a system with up to 32 CRTs and printing capabilities to be implemented.

The Sycor 250 Series features three different models. They are designated:

- Model 255 — a remote, stand-alone desktop unit
- Model 257 — a remote cluster unit for up to 32 terminals
- Model 258 — a remote cluster unit for 12 to 23 terminals. See Table 1 for Sycor 250 system characteristics.

Sycor is a leading manufacturer of intelligent terminal systems. In addition to the 250 Series, Sycor markets the Model 340 Communications Terminal System, the Model 350 Communications Terminal System, the Model 410 Single Terminal Processing System, and the Model 440 Clustered Terminal Processing System. These systems can be used for a variety of application purposes including remote order entry, remote batch processing, and local stand-alone processing. The Sycor 250 was announced in May 1973; first deliveries began in October 1973.

COMPATIBILITY

The Sycor 250 "looks like" the IBM 3270 in every way, except for the 3270's ability to use IBM's Synchronous Data Link Control (SDLC). Sycor has yet to announce SDLC capabilities for any of its terminals; until it does, the Sycor 250 will be unable to emulate IBM 3271 Control Unit 11 or 12. Barring SDLC modes, all front-end communications processors that support the IBM 3270 can also support the Sycor 250; some of these are IBM 2701, 2703, and 3705 and independent front ends that support the 3270 with binary synchronous communications (BSC). Similarly, the following software, which supports the IBM 3270, will also support the Sycor 250: BTAM, TCAM, VTAM, and teleprocessing methods under OS/360 in conjunction with an appropriate access method, such as CICS, IMS, or Video 370. Under DOS/360 the CICS program is usually used by way of BTAM, whereas OS/VS1, OS/VS2, and DOS/VS2 can use IMS/VS and CICS/VS using VTAM. IBM and Sycor components cannot be mixed in the same subsystem.

Sycor 250s are not compatible with other products in Sycor's intelligent terminal product line; these are the

HEADQUARTERS

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100 Phoenix Drive
Ann Arbor MI 48104
(313) 971-0900

Table 1. Sycor 250 Series: Specifications

MODELS	255, 257, 258
Control Unit	251 (Models 257 and 258), 255 (Model 255)
Configuration Size	255 (stand-alone), 257 (up to 32 terminals), 258 (12 to 23 terminals)
Buffer Size	480; 1,920
Aux Printer	66, 120, 180 cps bidirectional
Aux Mag Tape Unit	No
Aux Flexible Disc	500K char
DISPLAY UNIT	
Screen Size (char)	480; 1,920
Char per Line	40; 80
Lines per Display	12; 24
Paging Capacity	None
Char Set (char)	64 std, 90 opt
Char Generation	7 × 9 dot matrix
EDITING/ FORMATTING	
Horizontal Tab	Yes (also backtab)
Char Typeover	Yes
Line Insert/Delete	No
Char Insert/Delete	Yes
Split Screen	Yes
Partial Transmit	Yes
Scrolling	No
DATA TRANSMISSION	
Line Facility	Voiceband (leased, private or dial-up)
Line Speed (bits/sec)	1,200; 2,000; 2,400; 3,600; 4,800
Line Mode	Half-duplex, 4-wire
Line Code	EBCDIC or ASCII
Synchronization	Binary sync (BSC)
ERROR CONTROL	
Detection	CRCC or VRC/LRC (BSC)
Correction	Autotransmit (BSC)
FEATURES	
Integral Modem	No
Portability	No
Polling/Addressing	Yes
Numeric (kybd) Cluster	Std on keypunch
Switchable Speeds	No
Detachable Keyboard	Yes
COMPATIBILITY	
Computer System	IBM S/360, S/370
Terminal	3270, 3275
Bell System Dataset	201 A/B series, 208
FIRST DELIVERY	October 1973

Sycor Model 340 or 350 Communications Terminal System, the Sycor Model 410 or 440 Terminal Processing Systems.

PERFORMANCE AND COMPETITIVE POSITION

From the time the IBM 3270 Information Display Station was first announced in 1972, it received competition from several quarters of the IBM-compatible replacement market. IBM 3270 replacement systems continue to blossom even in light of IBM's announcement of SDLC 3270 terminal models. In the future, 3270 replacement systems without SDLC capabilities will probably be of interest to a marginal part of the market. The biggest market share of the 3270-compatible business will undoubtedly go to the vendor who first hops onto the SDLC bandwagon.

There are a large number of 3270 replacement terminals, each offering special features and capabilities. In the intelligent terminal category, Sycor's competitors include Raytheon Data System PTS-100; Incoterm SPD 10/20, 10/25, and 20/20; Four-Phase IV/40, IV/50, and IV/70; ADDS System 70; Sanders 800 and 8000 Systems (SDLC capabilities available); Datapoint 1100 Series; and Burroughs TC5100 Series. Other 3270 emulators without intelligent terminal capabilities include Computer Optics C077, Courier, Terminal Communications 275, GTE/IS, ADDS, Genesis One, and Sintra. All the replacements offer lower prices and expanded capabilities over the IBM 3270.

In the face of this diversified market, Sycor has developed a competitively priced system that allows for user expansion; it also has a number of extensions beyond IBM's capabilities without drastically departing from IBM's basic design. However, IBM's 3270 is a dumb CRT terminal hooked to an intelligent processor; and Sycor's 250 is an intelligent terminal hooked to a less intelligent line control unit. The design of the Sycor 250 makes it more cost-effective for smaller cluster configurations, whereas large cluster configurations benefit from an arrangement like that of the IBM 3270.

In most cases, however, users who want a system capable of a variety of diverse functions, as well as 3270-like communications and data entry, should consider one of the multipurpose programmable terminals which has appropriate software already developed. For a minimum system, some of the vendors of those terminals have price tags close to Sycor's. The 250, on the other hand, is designed to compete directly with the 3270; thus, additions and enhancements are presently centered upon improving the performance of the 3270 rather than on supplying a number of alternative uses for the same basic hardware.

CONFIGURATION GUIDE

Like the 3270 it replaces, Sycor's 250 is a family of CRT display stations, control units, and printers that can be configured in a variety of ways (see Table 1). The Model 255 is a remote, stand-alone desktop version that attaches directly to a communication line by way of a high-speed modem. The Model 257 attaches to the 251 Line Control Unit in remote clusters of up to 32 terminals. Model 258, a single station that incorporates a 251 Line Control Unit and a display station in a single cabinet, is intended either for small clusters of up to 12 terminals or printers using point-to-point cabling or for up to 23 terminals or printers using daisy chaining.

Any Sycor character printer (2606, 2612, 2618), the 2550 Light Pen, and the 2555 Magnetic Stripe Badge Reader can all be attached directly to the 255, 257, or 258 terminal when desired. A 500K-character flexible disc option is available for all models.

The 251 Line Control Unit has two submodels that differ in buffer size: Model 251-1 controls displays and printers with 480-character buffers only, while Model 251-2 controls displays and printers with either 1,920-character or 480-character buffers. Transmission speed is determined partly by whether or not clocking is in the 251 (1,200 bits per second) or in the modem (2,000, 2,400, 3,600, 4,800, or 7,200 bits per second). Any Bell or equivalent modem can be interfaced. The standard 251 has two cables; each can connect up to four devices (buffered printers or displays) in daisy-chain fashion. The 2510 Device Adapter adds four more lines. Although four 2510s can be added to a system for a total of 18 lines, only 32 on-line devices can be connected to a 251.

The 251 is responsible for blocking (with null suppression), checking, and other functions relating to the BSC line discipline. Cyclic redundancy checking and correction (CRCC) is generated and checked for EBCDIC transmission, while vertical and longitudinal redundancy checks are employed for ASCII. Transmission between the 251 and 257 is half-duplex, with each character acknowledged by the receiving unit before transfer of the next. The standard transmission speed is 2,400 or 3,600 bits per second; other speeds are selectable as options to replace the standard speed.

All Sycor 250 models have an 8K-byte, read-only memory to store the microprocessing firmware needed to execute the 3270 command repertoire. The 1K-byte user-programmable memory can be increased to 6K bytes in 1K increments. These 1K to 6K bytes of memory are used to implement FIL, Sycor's Field Instruction Language, which is available to the user for the generation of fill-in-the-blank formats, as well as capacity control, check-digit verification, arithmetic operations, table comparison, and other data validation features.

CRT. The CRT can be either of two versions: a 480-character CRT with 12 lines of 40 characters, designated Submodel 1; or a 1,920-character CRT with 24 lines of 80 characters, designated Submodel 2. Each CRT also has a status line at the top, which is not directly accessible, for messages to the operator. The standard 64-character set can be supplemented by a 26-character lowercase option.

The CRT display employs formatting attribute characters and includes all the editing and command controls of the IBM 3270. Format control characters indicate the start of a field and field characteristics in terms of brightness (off, normal, bright), protected versus unprotected status, and data type (numeric or alphanumeric). Characters are inserted or deleted with the aid of Insert and Delete control keys; corrections can be "typed over" an erroneous character.

Like IBM's 3270, the 250 does not provide for inserting whole lines and similar advanced editing and blocking functions, such as paging and scrolling. The screen can be split into several "records" which, together with the field protection feature, allows a fill-in-the-blanks form to be displayed. The operator's fill-ins constitute a separate record. As a result, screen contents can be partially transmitted, leaving the protected "form" behind for more entries. These capabilities correspond to the capabilities of the 3270.

Keyboard. A choice of two keyboards is offered: the 2530 with a typewriter arrangement and the 2533 with a data entry (keypunch) arrangement. A 12-key pad, grouped to the right of the keygroup, is optional on the 2530 typewriter-style board but unavailable for the 2533 data entry board. Program access keys, in addition to the main keygroup are common to both. The 12-key pad can be configured either as 12 program function keys or as 12 dual-function keys with the program functions in uppercase and the numeric pad in lowercase.

In addition to input from the keyboard, Sycor supplies a light-pen option functionally equivalent to IBM's. It is intended for "menu" and multiple-choice applications where a question is asked of the operator and the answer is selected from a limited number of choices.

Printer. Sycor offers a series of microprocessor controlled matrix printers for the Sycor 250 Series. The printers are manufactured by Sycor and are available with all other terminal systems in the Sycor product line. They feature bidirectional printing and vertical and horizontal slewing to optimize throughput. A 12-key function pad on the printer is used for setting margin widths, forms lengths, vertical and horizontal tab positions, and for executing commands. The printers are equipped with a snap-out tractor and interchangeable pin-feed or friction-feed paper handling mechanisms. Multi-part copies up to 5 forms can be printed. All of the printers for the Sycor offer a standard set of 64 characters in a seven by seven dot matrix and an optional 96 character set in a seven by nine dot matrix. The three buffered printers are Models 2606-2, 2612-2, and 2618-2; they print at 66, 120, and 180 cps respectively. The unbuffered printers are Models 2606-3, 2612-3, and 2618-3; they also print at 66, 120, and 180 cps respectively. Table 2 lists printer models and buffer sizes.

Buffered printer models essentially replace the corresponding CRT displays, so that a multipoint subsystem can consist of a mixture of on-line displays and buffered printers, all controlled by the same Model 251-1 or -2 Line Control Unit.

Table 2. Sycor 250 Series: Printer Models

Model	Speed (cps)	Buffering
2606-1	60 cps	480-Char Buffer
2606-2	60 cps	1,920-Char Buffer
2606-3	60 cps	Unbuffered
2612-1	120 cps	480-Char Buffer
2612-2	120 cps	1,920-Char Buffer
2612-3	120 cps	Unbuffered
2618-1	180 cps	480-Char Buffer
2618-2	180 cps	1,920-Char Buffer
2618-3	180 cps	Unbuffered

MAINTENANCE

Sycor markets its terminals, digital cassette recorders, and related devices in 34 countries of the world, including the United States, Canada, Japan, Israel, and Europe. Sales throughout Europe are handled through the Italian-based Olivetti company, which markets a slightly modified Sycor 340 terminal as the Olivetti DE 520 series. A similar arrangement with Mitsui has been made in Japan.

Sycor services its terminals in the United States and Canada through its own sales and service centers in 80 different locations, as well as through SORBUS, a subsidiary of MAI that is devoted to independent maintenance.

PRICE DATA

Model No.	Description	Purchase Price (Maint. not Incl) $	Monthly Rental (Maint. not Incl) 1 Yr $	Monthly Rental (Maint. not Incl) 3 Yr $	Monthly Maint. $
255-1	Stand-Alone Terminal (480 char)(1)	4,850	102	82	25
255-2	Stand-Alone Terminal (1,920 char)(2)	5,370	113	90	29
257-1	Display Station (480 char)(1)	3,450	87	70	21
257-2	Display Station (1,920 char)(2)	4,185	92	74	25
251-1	Remote Control Unit (for 480-char CRTs only)	2,850	92	74	19
251-2	Remote Control Unit (for 480- or 1,920-char CRTs)	4,330	133	106	23
258-1	Control Station (for 480-char screens & control unit)(1)	5,400	140	112	33
258-2	Control Station (for 1,920-char screens & control unit)(2)	6,700	185	148	38
2500	Flexible Disc	4,200	105	84	20
2501	Library Diskette	35	—	—	—
2510	Device Adapter (4 additional spokes; 8 half spokes, up to 16 devices/device adapter)(3)	800	26	21	4
2540	Programmable Memory (1K bytes)	210	7	6	2
2545	FIL Control Firmware(4)	320	10	8	2
2550	Light Pen	740	20	16	5
2555	Magnetic Card Reader (operator ID)	880	20	16	10
2557	Security Lock (incl 2 keys)	50	—	—	—
2601-1	66 cps Matrix Printer (480 char-buffer)	5,680	95	76	30
2612-1	120 cps Matrix Printer (480 char-buffer)	8,100	140	112	45
2618-1	180 cps Matrix Printer (480 char-buffer)	11,000	180	144	55
2602-2	66 cps Matrix Printer (1,920-char buffer)	6,600	120	97	30
2612-2	120 cps Matrix Printer (1,920-char buffer)	9,020	165	133	45
2618-2	180 cps Matrix Printer (1,920-char buffer)	11,830	205	165	55
2606-3	66 cps Matrix Printer (unbuffered)	4,800	115	93	25
2612-3	120 cps Matrix Printer (unbuffered)	5,900	135	109	40
2618-3	180 cps Matrix Printer (unbuffered)	8,060	175	141	50

Notes:
(1) Includes 1K RAM for screen.
(2) Includes 2K RAM for screen.
(3) Up to 4 of these may be installed in a 251. Only 1 may be installed on a 258.
(4) At least one 2540 must be ordered.

SYCOR INC

290 Display System

Sycor's new 290 on-line display system, which will compete head-on with IBM's popular 3270, is shown in this configuration having a control unit, three display stations and a Sprinter™ bidirectional printer.

OVERVIEW

The SYCOR 290 Display System is a microprocessor-based terminal system designed by Sycor Incorporated as a plug-compatible replacement for the IBM 3270 Information Display System. The 290 is available in three configurations for either remote or local attachment to an IBM channel. Any host computer system which supports an IBM 3270 System can support the Sycor 290 Display System. The Sycor 290 supports BSC (Binary Synchronous Communications) or SDLC (Synchronous Data Link Control) protocols over communications lines at speeds from 1200 bps to 9600 bps.

The Model 291 Remote Cluster Control Unit attached to a communications line can accommodate any combination of up to 16 display stations and/or printers. The 291 is equipped with twin processors that divide system tasks: the first master processor handles all I/O functions; the second subordinate processor takes care of all system keying and display formatting.

The Model 296 Control Station is a single station display which can operate as a mini-cluster controller and support up to eight display stations and printers.

The Model 292 Local Cluster Control Unit attached directly to the IBM channel, like the Sycor 291, can support up to 16 display stations and printers.

All Sycor 290 system configurations utilize a 1,920-character screen display with a 7 x 9 dot matrix for upper case and 7 x 12 dot matrix for lower case characters. The same screen attributes and control characters found on the IBM 3270 are featured by the Sycor 290 Display System. Six different keyboard styles are available, all virtually identical to IBM 3277 keyboards. The display station has a cable-connected keyboard and can operate at distances up to 2,000 feet from the control unit. Optional display station features include a light pen, a numeric function pad, a badge reader, and a security key lock.

Also available with the 290 Display Station is Sycor's bidirectional, microprocessor-based Sprinter™ printer with speeds of 66, 120, and 180 characters per second.

Sycor is a leading manufacturer and supplier of display terminal systems and computer peripherals for the data processing industry. First 290 delivery was in November 1977.

PERFORMANCE AND COMPETITIVE POSITION

The Sycor 290 Display System was designed with a specific market and selling strategy in mind: the on-line, IBM 3270 marketplace. Because the 3270 is an IBM product, it became the industry's de facto standard. With domestic installations of 3270-type terminal systems surpassing an "if-sold" value of $1 billion, Sycor has entered a most lucrative and competitive market.

The Sycor 290 is a natural extension of the Sycor 250 terminal product line, originally introduced in late 1973. Many of the features found on this system (1,920 character display, bidirectional printer, remote/local cluster configurations) have been incorporated by the 290. The addition of Synchronous Data Link Control (SDLC) protocol and local remote cluster configuration (Model 292) make the 290 more competitive with the 3270.

HEADQUARTERS

Sycor Inc
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Since Sycor's avowed intention is to phase the 250 system out of production, units scheduled for delivery after December 1977 will be converted to the 290 system. Customers who so desire may convert their installed 250 systems to purchase status or may obtain a long-term renewal lease. A second alternative available is conversion of Sycor 250 installations to the lower-priced 290 Display Systems.

From a performance standpoint the 290 operates just like a 3270. Any host computer system which supports a 3270 with a 1,920-character display can support the Sycor 290. Perhaps the most salient feature of the 290 is its 3270 program compatibility: there is no need to modify existing applications software, and future IBM program releases will be fully supported.

Another feature found on the Sycor 290 that IBM and other vendors' products lack is the unique 7 x 9 dot matrix display of upper case characters and 7 x 12 dot matrix display of lower case characters. This, coupled with the plastic shield which diffuses light and reduces glare, makes the 290 display easy on the eyes and easy to operate.

In addition to Sycor, IBM's primary 3270 competitors include the Courier 270, Harris 8170/8180, and Raytheon PTS 100 terminal display systems. Sycor's primary competitor however, is IBM 3270 Information Display System.

All three configurations of the Sycor 290 Display System (Model 291 Remote, Model 296 Mini-Remote, and Model 292 Local) are priced 20 percent below the IBM 3270, a factor many prospective users will find attractive. Since Sycor also offers quantity discounts and long-term leases (42 months), it has a competitive price advantage over IBM.

SYSTEM DESIGN

The Sycor 290 Display System consists of four functional components: the Controller, Communications Interface, CRT Display, and Printer.

Controller

The controller can operate using BSC or SDLC communication protocols and is available in three configurations:

- Model 291 Remote Cluster
- Model 292 Local Cluster
- Model 296 Standalone/Mini Cluster

Models 291 and 292, and the controller portion of the 296, are actually microprocessors programmed to perform their respective control functions. The Model 291/292 controllers feature twin microprocessors with a combined memory of 72K bytes. Each microprocessor reserves 16K bytes for exclusive systems use. The shared memory allows communication between both processors. The 291 and 292 control units each contain a cassette tape drive which is used to load the system configuration and system diagnostics. The cassette tape drive is attached to the master processor and communications interface. It controls the system initialization, error checking, all communications protocols, and 3270 command processing. A subordinate processor is attached to the keyboards and printers, controlling keystroke processing, display images, maintenance and printer functions.

The Model 296 control unit has 28K bytes of ROM (Read Only Memory) and an appropriate amount of RAM (Random Access Memory) to control the device buffers and data areas.

Diagnostic routines are supplied on cassette on Models 291 and 292 and are pre-programmed on Model 296. Sycor diagnostics provide technical information on the location and nature of a malfunction.

Communications Interface

The Binary Synchronous Communications Interface for terminal controllers operates using 2-wire or 4-wire leased (private) communication lines in half-duplex transmission. Both EBCDIC and ASCII transmission codes are supported. SDLC communication is over private communications lines in full-duplex mode. SDLC communications require the EBCDIC or ASCII transmission code feature to be installed on the Model 291-12 and Model 296-12.

CRT Display

The Model 297 CRT display station consists of a 15-inch display and detachable keyboard. A total of 1,920 characters are displayed in 24 lines of 80 characters each; a 7 x 9 dot matrix forms the upper case characters, and 7 x 12 dot matrix forms the lower case characters. Six different keyboard styles are available on the Model 297:

- Model 2930 — Standard 66-Key Typewriter Keyboard in either EBCDIC or ASCII format.
- Model 2931 — A 66-Key Data Entry Keyboard designed for high-volume applications.
- Model 2932 — A 66-Key Keypunch Keyboard arrangement.
- Model 2933 — A 78-Key Typewriter Keyboard in EBCDIC or ASCII format. This keyboard combines the 66 standard keys with 12 Program Function Keys.
- Model 2934 — A 78-Key Operator Console Keyboard for host processor communications.
- Model 2935 — A 78-Key Typewriter Keyboard with 12 dual function keys (program control plus a numeric pad).

In addition to the keyboards, other options are available on the Sycor 290 Display System to enhance system performance: light pen, badge reader, security key lock, and audible alarm.

Printer

On the 290 Display System, Sycor offers a microprocessor-controlled, bidirectional serial printer called the "Sprinter." Three printing speeds are available: 66, 120, and 180 characters per second. Characters are generated by a 7 x 7 dot matrix with the standard character set and a 7 x 9 dot matrix with the optional 96-character set. Two interchangeable paper feed mechanisms, tractor feed and tear bar tractor, accommodate paper from 4 to 15 inches wide and up to six parts. Standard features on all Sprinter models include a 64-character ASCII or EBCDIC character set, auto printhead adjustment, vertical skewing at 50 lpm, auto double line feed, and electronic vertical tab/form feed.

Optional features which can be ordered on the Sprinter include auto horizontal skew at 350 cps, 96-character ASCII or EBCDIC character set, and paper feed baskets or removable stand.

Table 1 provides a summary of Sycor 290 technical specifications.

COMPATIBILITY

The Sycor 290 is completely compatible in terms of code and communications protocol with any host processor which supports the IBM 3270. Any system which can support BSC/SDLC communications and a 3270 display system can also support a 290 cluster or standalone display. Among these are:

- Burroughs B-6700 and B-6800
- Honeywell Series 6000
- IBM System/3 — All Models
- IBM 1130 and 1800
- IBM System/360 Model 25 through 195
- IBM System/370 Model 115 through 168

As a plug-compatible replacement for the IBM 3270, the 290 requires no hardware or software modifications. Functional capabilities found on the 3270 (attribute controls, character addressing, and keyboard operations) are identical to those of the 290. Both ASCII and EBCDIC transmission code and character sets for display, keyboard, and printer operations are provided.

DATA COMMUNICATIONS

The Sycor 290 communicates synchronously (using BSC or SDLC protocol) at 1200 to 9600 bps in half or full duplex mode. Either EBCDIC or ASCII transmission code is possible.

Data transmission at 1200 bps is internally clocked by the 290. All other transmission codes/speeds are clocked externally by a modem. Sycor offers a 2400 bps modem for data transmission over nonswitched communications lines. This modem also provides fully compatible Bell 201B and 201C synchronous operations at 2400 bps over switched or private telephone lines. Autodial capability is standard.

Table 1. Sycor 290 Specifications

Model	291	292	296
Control Unit			
Configuration	Remote Cluster	Local Cluster	Standalone
Buffer Size (char)	1,920	1,920	1,920
Max No. Displays	16	16	8
@ char/display	1,920	1,920	1,920
Aux Printer, bi-directional	66, 120, 180 cps	66, 120, 180 cps	66, 120, 180 cps
Aux Mag Tape Unit	No	No	No
Display Unit			
Screen Size (char)	1,920	1,920	1,920
Char per Line	80	80	80
Lines per Display	24	24	24
Paging Capacity	None	None	None
Char Set (char)	64 std, 96 opt	64 std, 96 opt	64 std, 96 opt
Char Generation (dot matrix)	7x9 - Up Case 7x12 - Low Case	7x9 - Up Case 7x12 - Low Case	7x9 Up Case 7x12 Low Case
Editing/Information			
Horizontal	Yes	Yes	Yes
Char Typeover	Yes	Yes	Yes
Line Insert/Delete	No	No	No
Char Insert/Delete	Yes	Yes	Yes
Split Screen	Yes	Yes	Yes
Partial Transmit	Yes	Yes	Yes
Scrolling	No	No	No
Data Transmission			
Line Facility	Voicegrade	Voicegrade	Voicegrade
Line Speed (bps)	1,200-9,600	1,200-9,600	1,200-9,600
Line Mode	HDX; FDX	HDX; FDX	HDX; FDX
Line Code	ASCII, EBCDIC	ASCII, EBCDIC	ASCII, EBCDIC
Synchronization	BSC, SDLC	BSC, SDLC	BSC, SDLC
Interface	Sycor Modem	Sycor Modem	Sycor Modem
Error Control			
Detection	CRCC or VRC/LRC	CRCC or VRC/LRC	CRCC or VRC/LRC
Correction	Auto Retransmit		
Features			
Integral Modem	No	No	No
Portability	No	No	No
Polling/Addressing	Yes	Yes	Yes
Numeric (kybd) Cluster	Yes	Yes	Yes
Switchable Speeds	No	No	No
Detachable Keyboard	Yes	Yes	Yes
Compatibility			
Computer System	IBM Sys/3; 1130; Sys/360; Sys/370; Burroughs B6700/6800; Honeywell 6000		
Terminal	IBM 3270 Series		
Bell System Data Set	201B; 201C		
First Delivery	November 1977		

DATA COMMUNICATIONS SOFTWARE

The Sycor 290 is fully supportive of and can interface with the following data communications/management systems:

- IBM BTAM — Basic Telecommunications Access Method under DOS, DOS/VS, or OS
- IBM TCAM — Telecommunications Access Method under OS

- IBM DIDOCS — Display Console under System/360
- IBM SDS — Status Display under System/360 OS
- IBM VIDEO/370 — Under both OS and DOS on System/360 and 370
- IBM DATA/360 — Under both OS and DOS on System/360 and 370
- IBM IMS — Information Management System under OS on System/360 and 370
- IBM IQF — Interactive Query Facility for IMS
- IBM CICS — Customer Information and Control System under both OS and DOS and System/360 and 370
- IBM TSO — Time Sharing Option under OS on System/360 and 370
- Burroughs NDL — Network Design Language on B6700 and B6800
- Honeywell GERTS — General Remote Terminal System under GCOS operating system
- Honeywell NPS — Network Processing System under GCOS operating system

MAINTENANCE

Sycor provides maintenance service from its own sales and service offices located in more than 100 major cities throughout the United States and Canada. In addition, contractual arrangements have been made with Sorbus (a subsidiary of MAI) to service secondary population centers.

Sycor claims that their service representatives usually restore operation within two hours after placement of a service call. This rapid repair time is facilitated by the modular design of Sycor's system components as well as by the comprehensive diagnostic routines provided with the equipment. Sycor diagnostics provide information relating to the nature and location of a malfunction and also suggest the most likely causes of the trouble.

Maintenance is included in the monthly lease price of the 290 Display System.

PRICE DATA

Sycor offers 3-month, 12-month, 24-month, and 42-month lease plans. Quantity discounts are also available. Maintenance is not included in the lease price.

Model	Description	Lease Price (Maint not Incl) 12-mo. $	42-mo. $	Purchase Price $	Maint $
291-2	Remote Cluster Control Unit (BSC Communications)	219	164	11,530	50
292-2	Local Cluster Control Unit	307	230	13,670	85
296-2	Control Station (BSC Communications)	127	95	7,520	40
291-12	Remote Cluster Control Unit (SDLC Communications)	219	164	11,530	50
296-12	Control Station (SDLC Communications)	127	95	7,520	40
2919	Display Adapter	12	9	650	6
2920	Distant Print Adapter	9	7	450	5
2912	EBCDIC Transmission Code	NC	NC	NC	NC
2913	ASCII Transmission Code	NC	NC	NC	NC
2923-1	2400 bps Sycor Modem (201C Compatible)	50	38	2,000	10
2960	1200 bps Sycor Modem (202C Compatible)	25	19	1,000	7
297-21	Display Station	49	37	2,700	8
2930	66 Key Typewriter Keyboard	NC	NC	NC	NC
2931	66 Key Data Entry Keyboard	NC	NC	NC	NC
2934	66 Key Data Entry/ Keypunch Keyboard	NC	NC	NC	NC
2933	78 Key Typewriter Keyboard	(1)	(1)	50	NC
2932	78 Key Console Keyboard	(1)	(1)	50	NC
2935	78 Key Typewriter Keyboard with Dual Function Keys	(2)	(2)	100	NC
2938	Dual Case	NC	NC	NC	NC
2950	Light Pen	20	15	1,000	5
2955	Badge Reader	20	15	1,000	5
2957	Security Key Lock	NC	NC	50	NC
29606D	Sprinter – 66 cps	85	64	4,800	30
29612D	Sprinter – 120 cps	99	75	5,150	45
29618D	Sprinter – 180 cps	142	107	7,080	55
29620	Tractor Feed	18	14	700	5
29624	Tear-Bar Tractor	18	14	900	5
29635	Stand for Tear-Bar Tractor	5	4	250	NC
29640	6/8 lpi – switch	10	8	400	NC
29642	10/16.5 cps – switch	15	11	600	NC

PRICE DATA (Cont.)

Model	Description	Lease Price (Maint not Incl) 12-mo. $	42-mo. $	Purchase Price $	Maint $
29644	Fast Horizontal Slewing over spaces	15	11	600	5
29650	Upper/Lower Case EBCDIC	15	11	675	3
29652	Upper Case EBCDIC	NC		NC	NC
29655	Upper Case ASCII	NC		NC	NC
29660	66-120 cps Conversion Kit	NA	NA	1,000(3)	NA
29662	66-180 cps Conversion Kit	NA	NA	3,020(3)	NA
29664	120-180 cps Conversion Kit	NA	NA	2,020(3)	NA
4430	Dual Twisted Pair Display Cable cut to length(1)			$30 = .20/ft	
4433	Bulk Display or Distant Printer Cable - Dual Twisted Pair(2)			.15/ft	
4434	Connector Kit for Bulk Cable			10	
2978	50 ft. Modem Cable			25	

Notes:
(1) Connectors installed by Sycor
(2) Connectors not installed
(3) Plus $200 installation charge
NC No charge
NA Not applicable

SYCOR INC.
Models 340 and 350 Intelligent Communication Terminal Systems

OVERVIEW

The Sycor 340 and 350 are intelligent, single-terminal display systems used primarily as order-entry points in distributed processing networks. As components of a distributed network they are capable of both stand-alone and remote-batch processing. In addition, the 340 and 350 terminals can communicate with one another, with the Sycor 440 Clustered Terminal Processing Systems, or with host computers using IBM's 2770, 2780, or 3780 remote-batch terminal disciplines, as well as IBM's HASP procedures in synchronous or binary-synchronous modes of transmission. However, the 340, 350, or 440 systems can not communicate with Sycor's other intelligent terminal, the Model 250.

Most Sycor 340s and 350s are used as order-entry terminals, but they are also used as low-volume local site processors. The limited flexible disk storage space on the 340 and 350 restricts their stand-alone processing capabilities; Sycor intends its larger, upward-compatible Model 440 for stand-alone intelligent processing. An option provided with the Model 340 — an ECMA/ANSI-compatible cassette recorder — enables the 340 to communicate with small business computers, such as the NCR 399, the Litton ABS 1300, and the small business models of Honeywell's Series 60 line. The cassette recorder permits Model 340 to be used for off-line data entry and off-line preprocessing.

The Sycor 340 and 350 models are functionally the same unit, but there are some configuration differences. Sycor 340 originally offered only cassette for secondary storage. Later, a flexible disk was made available as an option. The success of the disk option for the 340 led Sycor to repackage the unit and introduce a disk-based model, the 350. The 340 is still the cassette-based model, but flexible disks may be added optionally.

Sycor 350, the flexible disk-based model, cannot host cassettes, which is its only peripheral restriction. All other peripheral options are identical for the 340 and 350 models. The only other variation between the two units lies in the memory technology each uses. The 340 has 8K bytes of system memory implemented as read-only memory (ROM) and 1K bytes of user memory, expandable to 8K bytes, implemented as random-access memory (RAM). The 350 hosts a standard 16K bytes of RAM memory for both user and system use. Since the 350 requires 8K bytes of memory for system use, the total amount of user memory available is identical for both models. However, the exclusive use of RAM on the 350 permits it to be more adaptable to system changes that Sycor may wish to implement in the future. Table 1 lists the specifications for the Sycor 340 and 350.

Sycor 340's first delivery was in February 1971, and as of March 1977 there were 28,000 systems delivered. Sycor 350's first delivery was in June 1975, and as of March 1977 there were 2,000 systems delivered. Sycor is also the manufacturer of the Sycor 250 Intelligent Display System and the Sycor 440 Clustered Terminal Processing System. Sycor markets worldwide through Olivetti and Company, S.P.A., and Mitsui and Company Ltd.

Sycor also offers a packaged product, the Sycor 351, to fill the market's need for a low-cost data entry and printing system. The Sycor 351 consists of a Sycor 350 intelligent terminal system, communications capabilities, and a printer. Four different packages are available, depending upon the printer selected. In addition, the same options offered for the Model 350 are available for this system.

COMPETITIVE POSITION

The Sycor 340 and 350 terminals continue to appeal to a broad spectrum of the business market because of their

HEADQUARTERS

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Table 1. Sycor Models 340 and 350: Specifications

MODEL	340	350
MICROPROCESSOR		
Max Entry Stations	1	1
Max Input Devices	2	2
Max Output Devices	2	2
CRT Entry Buffer Size (char)	512	512
I/O Buffer Size (char)	256	256
Sys. Memory (bytes)	8K (ROM)	8K (RAM)
User Memory (bytes)	1K std, 7K opt (RAM)	8K std (RAM)
KEYBOARD ENTRY		
No. of Char Keys	56	56
No. of Control Keys	25	25
Numeric Pad	Yes	Yes
Max Record Size	512 bytes	512 bytes
Operating Modes	Batch; search; format; program	Batch; search; format; program
CRT DISPLAY OUTPUT		
Viewing Area (in.)	5.5 w X 4.75 h	5.5 w X 4.75 h
Screen Capacity (char)	576	576
Characters/Line	64	64
Lines/Display	8 data, 1 status	8 data, 1 status
Displayable Char Set	64 (uc ASCII)	64 (uc ASCII)
CASSETTE RECORDER		Not available
Cassette Capacity (char)	200,000	—
Read/Record Speed (ips)	12.5	—
Rewind Speed (ips)	120	—
Transfer Rate (bps)	10,000	—
FLEXIBLE DISKETTE		
Diskette Capacity	242,944/drive	242,944/drive
No. of Drives	2	4
Transfer Rate	31,250 char/sec	31,250 char/sec
COMMUNICATIONS		
Line Facility	Switched; leased	Switched; leased
Line Configuration	Point-to-point	Point-to-point
Line Speed (bps)	110-1200 async; 1200-4800 sync	110-1200 async; 1200-9600 sync
Transmission Mode	Half-duplex	Half-duplex
Transmission Code	ASCII, EBCDIC, & others opt	ASCII, EBCDIC, & others opt
Synchronization	Async/sync	Async/sync
Unattended Operation	Yes	Yes
Autodial	Yes	Yes
PERIPHERAL OPTIONS		
Card Reader (cpm)	250	250
Cassette Recorder	Formatting/Pooling	Formatting/Pooling
Line Printer	80, 165 cps; 300, 600 lpm; 132 col	80, 165 cps; 300, 600 lpm; 132 col
Other	Mag tape; flexible disk	Mag tape
COMPATIBILITY		
Computer System	IBM S/360, S/370	IBM S/360, S/370
Terminal	IBM 2770, 2780, 3780	IBM 2770, 2780, 3780
Control Procedures	IBM BSC, HASP III	IBM BSC, HASP III
Bell System Dataset	202C/D; 201A/B	202C/D; 201A/B
SOFTWARE		
Cassette Based	TAL	Assembler
Diskette Based	TAL II	TAL II

overall adaptability and a concentrated orientation toward order processing. Sycor has managed to keep the systems from becoming too sophisticated or complicated; therefore, the terminals' capabilities and prices match their applications. Intelligent terminals are increasingly adding high-powered peripherals and software that offer extended capabilities. In its place the extended-system power is welcome, but there are many functions in business that require only a moderate amount of processing power; order entry is one such function.

Sycor 340 and 350 are commonly compared with such systems as the Datapoint 1100 and the Incoterm 10/20 and 10/25 intelligent terminals. These systems all offer a moderate amount of processing power and provide capabilities ideal for many routine business functions.

The Datapoint 1100 offers many of the same hardware and software features as the Sycor 340 and 350, including cassette tape and diskette-based configurations. However, the Datapoint 1100 does not offer flexible configurations as the Sycor 340 does. Datapoint 1100 is either diskette or cassette based; it cannot host both types of storage on a single unit as can the Sycor 340. However, the newer Datapoint 1150 can be both diskette and cassette based.

Datapoint can boast a greater growth path for its Datapoint 1100 users; it manufactures and markets two small business computers, the Datapoint 2200 and 5500, which are upward-compatible with the 1100 intelligent terminal. These systems offer a smooth migration path as the need for additional processing requirements materializes. Sycor does offer an upward-compatible system for

multiterminal applications, the Sycor 440 Clustered Terminal System.

Incoterm 10/20 and 10/25 intelligent terminals offer many of the features of the Sycor 340 and 350 units. The Incoterm units can host cassette and diskette storage units like the Sycor models. The Incoterm models can be arranged to handle two displays and keyboards under control of one processor to permit sharing of resources; Sycor models are limited to a single keyboard/display. However, the Incoterm units lack a fast line printer; the fastest printer offered with the 10/20 and 10/25 models operates at 300 lines per minute versus line printer speeds of up to 600 lines per minute with the Sycor models. A decision between the Sycor and Incoterm units is highly dependent on a user's specific needs for single or dual displays and high-speed line printers. In terms of growth, Incoterm and Sycor are on par with one another; they both offer an upward-compatible clustered terminal system.

USER REACTIONS

A large city hospital has had three Sycor 350 terminals for about 1½ years. Two of the models are used in the hospital emergency room for data collection and patient processing and the third is used in the data processing office of the hospital to spool data from the floppy disk to magnetic tape, as well as to back up the other two models. The hospital had compared competing models (particularly the IBM 3741) before deciding on Sycor 350, which were chosen because:

- The IBM model does not have intelligence.
- The Sycor model has numerous capabilities.
- The Sycor 350 sends variable-length records.
- Sycor floppy disks carry more data than IBM.
- The IBM model is built into the table, bringing the CRT screen below the user's eye level.
- Sycor 350 is a tabletop model, enabling the display users to view the screen easily.
- The Sycor 350 possesses high computing power.
- Sycor 350 is well-organized internally with direct-access capability to the floppy disk and a movable keyboard attached to a 2-foot cable.

A defect of Sycor 350 is its inadequate installer-support, although this is improving. Since this hospital is not located in a major metropolitan area, there was no service representative available at first. However, there is now a service center closer to the user which provides adequate support. The Sycor 350s operate 24 hours a day, seven days a week, with minimum mechanical problems; the operators are entirely satisfied with the terminals.

A trucking common carrier, which has 82 Sycor 340s, has used the terminals to prepare freight bill invoices for about 1½ years. Data is transmitted to approximately 50 remote locations throughout a western state. This company found the edit language easy for its operators to learn, and the Sycor 340 relatively inexpensive as an intelligent-terminal system. However, the 8-line-character per display is limiting because a complete document cannot be put on one screen; the printer is too slow; and it is incapable of printing a sufficient number of carbons. Mechanically, the Sycor 340 is sound and no maintenance problems have occurred at the trucking firm.

SYSTEM DESIGN

Configuration Guide

The common components for all Model 340 configurations consist of a microprocessor, a CRT display, a typewriter keyboard with 10-key numeric pad, and one magnetic tape cassette recorder. Options for the Model 340 include a second magnetic tape cassette recorder, a flexible disk, a line printer (up to 600 lines per minute), computer-compatible magnetic tape, a card reader, and one synchronous or binary-synchronous communication line adapter.

The standard configuration for the Model 350 consists of a microprocessor CRT display, a typewriter keyboard with 10-key numeric pad, and a dual flexible disk with 500K characters of storage capacity. Options include two additional diskette drives, one synchronous or binary-synchronous communications line adapter, computer-compatible magnetic tape, a card reader, a series of state-of-the-art bidirectional matrix printers, and a line printer with speeds up to 600 lines per minute.

Mainframe

The mainframe of the Sycor 340 and 350 models is a desktop unit, which houses the basic components. Model 340's mainframe includes a processor with memory and a keyboard display and cassette tape drive in a single desktop cabinet. There is a provision in the 340 cabinet for adding a second cassette. All other peripherals are cabled to the 340.

The 350 mainframe consists of a processor with memory, a keyboard display, and dual flexible-disk drives, housed in a single desktop cabinet. As with the 340, all other peripherals are cabled to it.

Magnetic Tape Cassette

A basic 340 system includes a single cassette drive; a second drive can be added to the main chassis. The drives use Phillips-type cassettes and record data at 800 bits per inch for a maximum storage capacity of 200,000 characters per drive. Automatic read-after-write check is made on all data, and recovery from errors is performed by the terminal system.

Display Screen

The CRT displays the keyed-in alphanumeric data plus format control, status information, and format headings. Up to 576 characters may be displayed in nine lines of 64 characters each; usually eight lines contain data, and the

top line is reserved for display of terminal status, including mode of operation, error messages, accumulator totals, and I/O device selection.

Console Keyboard

The keyboard consists of standard typewriter keys, a 10-key numeric pad for numeric data entry, control keys and switches. In addition to the standard 26 uppercase characters, the keyboard will generate 33 punctuation and special symbol characters.

Flexible Disk

The flexible disk unit used by both Sycor models is a dual-disk unit. Each disk records up to 242,944 characters on 76 tracks: 73 for data, one for an index, and two for spares. Data is recorded in 128-character sectors. Access time is 100 milliseconds; head positioning time is 2.5 milliseconds per track. Transfer rate is 31,250 characters per second. The recording medium is an IBM 3740 diskette or its equivalent.

A dual-disk option is offered with Model 350 bringing the terminal's total capacity to four flexible disks. This option provides Model 350 users a million characters of direct-access storage for file management and local inquiry/response applications.

Printers

Sycor offers both serial and line printers for the 340 and 350. The 3484 is an 80 cps matrix serial printer, which can print up to 6-part sprocket-fed forms up to 14⅞ inches wide. The 3485 is a faster matrix serial printer, operating at 165 cps. In addition, Sycor offers three bi-directional matrix printers: the 3606 a 60 cps printer, the 3612 a 120 cps printer, and the 3618, a 180 cps printer. These state-of-the-art bidirectional printers support dynamic fine tuning by a 12-key operator function pad. Line printers available are the 3486/3586, a 300 lpm printer, and the 3494/3594, a 600 lpm printer.

Sycor offers another 300 lpm printer called the Strider. This belt printer is best utilized in locations that need high-speed bulk printing on a periodic basis throughout the work day. The other 300 lpm printer, the 3486/3586, is a more heavy-duty printer than the Strider and is best used on a regular basis throughout the work day.

Card Reader

The 3440/3540 card reader inputs 80-column punched cards at speeds up to 250 cards per minute. Data from cards can be recorded directly on cassettes in an overlapped batch mode for subsequent transmission, or one card at a time can be read in a nonoverlapped mode to enter fixed data on the CRT for mixing with the keyboard data stream.

Magnetic Tape

Sycor offers Model 3456/3556, 3457/3557, and 3459/3559 Magnetic Tape Units, which handle industry standard 7- and 9-channel tapes and are compatible with IBM800 and 1600 bit-per-inch tape units. Output is compatible with Honeywell and NCR as well as IBM magnetic tape drives.

COMMUNICATIONS CAPABILITIES

The Sycor 340 and 350 permit the attachment of a single binary synchronous or asynchronous communication line. Three communication interfaces enable binary synchronous transmission: Model 3465/3565 operates at 1,200 bps; Model 3466/3566 at 2,000 or 2,400 bps; Model 3468 at 3,600 or 4,800 bps; and Model 3568 at 3,600, 4,800 or 9,600 bps. The model 3464/3564 interface is TTY-compatible and offers asynchronous communications at 110, 150, 300, 600, and 1,200 bps. Two Sycor modems (BELL 202C and 201B/C compatible) are available.

Communications Software

Sycor supplies the following communications software packages: HASP Communications Feature (2770 RJE, 2780RJE, or 3780RJE). Interactive Timesharing, asynchronous transmit, asynchronous receive, and a Burroughs mainframe-compatible package.

HASP Communications Feature allows the 340 and 350 to communicate with an IBM360/370 running under OS-HASP. The Sycor program includes the EBCDIC transmission code with CRC checking. ASCII code with VRC/LRC, and peripheral control routines for the card reader and line printer. The 340 or 350 terminal is defined to the IBM computer as an IBM2770, 2780, or 3780 without transparency; the 340 or 350 must include one of the synchronous interfaces.

Interactive Timesharing allows the 340 or 350 to communicate with USASCII-oriented timesharing systems in an interactive half-duplex fashion. The program defines the communication code as 7-bit USASCII with one parity bit, one start bit, and one or two stop bits; the program requires the 3464 asynchronous interface.

Sycor offers a software package that provides Burroughs standard TC500 multipoint poll/select communications compatibility. Available on Model 350 and the Model 351 system, this protocol features asynchronous communications at 1,200 bps, ASCII transmission codes, and even parity with LRC error checking.

Network Control System (NCS)

A Network Control System (NCS) available on the Model 350 terminal provides the user with program control of network communications without the use of a host processor and front end. By the use of NCS auto-dial software in networks of regularly called terminals, a central Model 350 can set as a master station to control data

transmission to and reception from remote 350s without the need for an operator to dial the locations. A log is kept indicating each communications task's success or failure, as each task is attempted. Recovery from such incidents as a busy signal can be specified by the operator during initiation of NCS. After attempting all specified communications, NCS scans the log for communications tasks and automatically retries those which were not properly completed.

A remote Model 350 is also designed to operate as a secondary station in an unattended communications mode. It can automatically answer an incoming data call and, in response to a control record from either a CPU or a Model 350 master-station terminal, transmit indicated data files or receive data to indicated I/O devices. The unattended communications software can selectively print received data off-line after the telephone line has been disconnected.

Unattended Model 350 terminals can be dialed by the master station 350 or under direct CPU control by using IBM 2770, 2780, 3770, or 3780 communications under BTAM, TCAM, POWER, HASP, or GRASP set up to transmit the required control record to the unattended terminal. The communications configuration for all of the NCS software includes 256- or 512-character buffers, record blocking and deblocking, and standard IBM space compression and decompression.

The Network Control System, part of Sycor's Level D software release, also includes RJE software for IBM 2770 and 3780 emulation, an interactive Teletype simulator, and an enhanced version of Sycor's data entry programming libraries.

SOFTWARE

Recent additions to the Model 350's program library include configurable software and task-chaining capability, among other enhancements. The user-configurable system allows memory previously allocated for peripheral drivers to be freed for, and increase the size of, user data-entry programs. When employed, magnetic tape drivers are user-configurable with options which allow compatibility with mainframe and Sycor 340 and 350 formats. Task or command chaining provides operating system control of batch operations without user intervention.

Sycor offers two versions of its proprietary application language: Terminal Application Language and Terminal Application Language II (TAL and TAL II). TAL is used with cassette-based systems, that is, the 340; and TAL II is used with the diskette-based 350 system or the 340 system with the diskette option.

TAL

The basic terminal editing and checking capabilities (such as automatic duplication and skipping, check-digit verification, and range checking) are controlled by routines implemented in the system microprocessor's memory. Sycor has introduced true-user programmability with the addition of extra memory modules and its TAL, which allow users to develop their own custom-tailored checking and editing routines. TAL consists mostly of macro statements that can be linked to data-entry fields defined in the data-entry format on the CRT. The TAL program generator acts on the user-written field program and the data-entry field tables to generate the machine-language program for execution.

The TAL instruction set includes eleven check-digit instructions, three table-checking instructions, general data handling and manipulation instructions (including Move, Store, and Edit according to a mask), four arithmetic instructions, five test instructions (including range check and table lookup), four branch instructions, a verify instruction, and 12 I/O instructions for a total of more than 60 instructions.

TAL II

TAL II extends and improves on the original TAL. It offers local inquiry/response on the diskette storage and improves the data-entry capabilities. It can perform arithmetic operations, data movement, logical comparison, range checking, table lookup, field justification, format chaining, check-digit verification, field duplication, minus overpunch, subroutining, and I/O to any of eight different sequential, random, or indexed files or devices. Also incorporated in TAL II is a disk software package, which includes IBM2770 and 3780 communications compatibility, a sort program, a blocking utility, and EBCDIC diskette compatibility.

Utility software is available to create and maintain sorted, random, or indexed files for access by the TAL II program. Indexed access method improvements include a "read next" capability that allows sequential reading of base file records. A "write-indexed" instruction is also provided to allow the addition of records to indexed base file for future indexed access by key. New instructions provide the ability to name programs and field programs, define overlay statements, include I/O drivers in the program, and to skip to the top of the new page in the source listing.

Existing TAL programs can be converted to TAL II listings through a translator program. The input is an existing TAL program and the output is a TAL II source program, which can be processed by the TAL II generator to obtain a TAL II object program and listing.

MAINTENANCE

Sycor services its terminals in the United States and Canada through its own sales and service centers in over 90 different locations. Secondary population centers are serviced by Sorbus, a subsidiary of MAI. Service representatives usually restore operation in no more than two hours after placement of a service call. This rapid repair time is due

primarily to the modular design of the system components. Each system automatically cycles through a diagnostic procedure upon being powered on, and a set of disk-resident system and component diagnostics is provided with each system. Sales throughout Europe are handled through the Italian-based Olivetti company, which markets a slightly modified Sycor 340 terminal as the Olivetti DE520 Series. A similar arrangement with Mitsui has been made in Japan.

PRICE DATA

Model No.	Description	Purchase Price $	Monthly Lease (Maint. Incl.) 1-year $	Monthly Lease (Maint. Incl.) 3-year $
	SYCOR 340			
340	Intelligent communications terminal with one cassette	6,600	184	157
340E	Intelligent communications terminal with ECMA cassette	6,780	220	188
	SYCOR 350			
350	Intelligent terminal with dual flexible disk and 16K memory	9,600	292	253
351-1	Intelligent terminal with dual disk — 60 cps printer — synchronous communications	16,900	400	350
351-2	With 120 cps printer	17,100	465	405
351-3	With 180 cps printer	19,120	525	455
351-4	With 300 lpm printer	26,800	715	620
	OPTIONS			
3400	Dual flexible disk	4,000	125	107
3402	Second cassette with auto paging firmware	1,120	35	30
3421	Extended memory — 2K	400	15	13
3422	Extended memory — 3K	800	28	24
3423	Extended memory — 7K	1,400	51	45
3440/ 3540	250 cpm card reader	3,500	120	102
3456/ 3556	Magnetic tape drive (9 track, 1600 bpi)	11,800	395	342
3457/ 3557	Magnetic tape drive (7 track, 800 bpi)	7,200	210	178
3459/ 3559	Magnetic tape drive (9 track, 800 bpi)	7,200	210	178
3464/ 3564	Async communications adapter (110-1,200 baud USASCII)	600	21	18
3465/ 3565	Sync communications adapter (1,200 bps USASCII)	900	32	28
3466/ 3566	Sync communications adapter (2,000/2,400 bps USASCII)	900	32	28
3468/ 3568	Sync communications adapter (3,600/4,800 bps USASCII - 3468; 3,600/4,800/9,600 bps USASCII - 3568	900	34	30
3491/ 3591	Auto dial	800	30	26
3520	Quad disk option	4,000	125	107
	PRINTERS — with tractor, basket, and stand (friction and pin feed available)			
3484	80 cps matrix printer	5,600	155	133
3485	165 cps matrix printer	6,600	250	205
3606	60 cps bi-directional, matrix (350 only)	5,600	155	133
3612	120 cps bi-directional, matrix (350 only)	6,600	218	190
3618	180 cps bi-directional, matrix (350 only)	8,620	276	242
3486/ 3586	300 lpm line printer	16,300	470	405
3494/ 3594	600 lpm line printer	20,800	650	556
3730	Strider 300 lpm belt printer	12,000	410	361
	SOFTWARE			
	Level D software	35/diskette; 50/2 diskette set		
	Level E software	50/2 diskette set		

Note: Peripherals with two model numbers list Sycor 340 model number first and Sycor 350 model number second.

SYCOR INC

400 Series Processing Systems

OVERVIEW

Sycor 400 Series Processing Systems are a family of intelligent terminals designed for distributed data processing applications that require extensive data editing, manipulation, and reporting capabilities. The 400 Series terminals feature from 24 to 64K bytes of RAM and from 2.5 to 20 million characters of fixed disk storage, concurrent processing, shared files for inquiry applications, and communication with remote computers. The systems include a central processor and fixed disk, alphanumeric display terminal, a cassette or flexible disk as a local interchange medium, and a variety of peripheral devices: line and matrix printers, a magnetic tape drive, cartridge tape drive, and either synchronous or asynchronous communications capabilities.

The 400 Series includes two models: the 440 and 410. The Model 440 is a clustered data entry system that can accommodate up to eight display stations. With the 440, Sycor brings the economies of shared processor logic to the user who requires multiple stations at a single location. The 440 is clearly cost effective over either the Sycor 340 or 350 in clusters of three or greater and, depending upon the user application, may prove more versatile even in two-station configurations.

The Model 410 is a single display station designed to satisfy limited keying requirements in a data entry or distributed processing network. It provides the user with expanded RAM memory, the same software capabilities as the Model 440, but less disk capacity.

A full set of support software is offered for the specialized needs of the distributed data processing user. The user facilities include TAL II, an enhanced version of the Terminal Application Language (TAL) developed for the earlier Sycor 340. Sycor has recently announced enhancements to its subset of ANSI COBOL which allows COBOL programs to control keying activities on the display screen, thereby allowing the user to do distributed data entry and processing tasks in COBOL. The user also can run both TAL II and COBOL concurrently, with TAL II in the foreground and COBOL in the background. The introduction of BASIC extends the capabilities of the 400 Series by providing mathematical and problem solving capabilities. There is no native assembly language available to the user. Remote teleprocessing programs are available, using either asynchronous protocols or remote job entry disciplines. A special program allowing specification of control breaks, field totaling, and arithmetic field operations is provided. Files may be sorted by use of a Sort program; a set of data transfer utilities to edit, pack, reformat, copy, and create index files is provided. A recent software announcement provides additional utilities and allows the user to dynamically reconfigure the memory structure and resident software of their system to permit operation as a clustered intelligent data entry device, an RJE terminal, a satellite printing station, a COBOL processor or a system with multiple display data entry operating in the foreground and concurrent processing in the background. All of these facilities can operate concurrently and may be initiated by any of the video display stations.

With the 400 Series, Sycor is following the natural product upgrading of its earlier Sycor 340/350 Series of intelligent terminals. Considerable emphasis is placed by the vendor on the compatibility within its line; the Sycor 400 Series are compatible with the 340/350 Series, but none of these units are compatible with Sycor's on-line 3270-compatible 290. Table 1 lists the overall characteristics of the 400 Series Processing Systems.

Sycor has recently announced that Data Dynamics, Inc. will be a distributor for Sycor's entire line of intelligent terminals and distributed data entry and processing systems. Sycor products will be offered for either purchase or lease from Data Dynamics, Inc., Lake St. Louis Office Center, St. Charles County, Missouri.

Model 440 deliveries began in the first quarter of 1976; Model 410 deliveries began in the fourth quarter of 1976.

HEADQUARTERS

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Table 1. Sycor 400 Series Processing Systems: Specifications

Microprocessor	
Main Memory (bytes)	24–64K (440); 40–64K (410)
Programming Languages	TAL II, COBOL, BASIC
Max Entry Stations	8 (440); 1 (410)
Auxiliary Storage	
Type	Sealed movable head disk
Capacity (bytes)	5–20M (440); 2.5–10M (410)
Seek Time	10–100 msec; 70 msec avg
Transfer Rate	5M bps
Keyboard Entry	
Console Layout	Typewriter or data entry
Numeric Cluster	Yes
No. of Keys	63
No. of Char	26 alphabet, 10 numeric, 32 special symbol, 23 function keys
CRT Display Output	
Viewing Area	7 x 9-1/2 in.
Screen Capacity	576 char
Max Char/Line	64
Max No. Lines	8
Char Type	5 x 7 dot matrix
Cassette Recorder	
Attachment Limits	0 or 1
Capacity	200,000 char
Transfer Rate	1,000 cps
Rewind Speed	120 ips
Flexible Disk	
Attachment Limits	0 or 1
Capacity	243,000 char
Latency Time	83 msec avg
Avg Positioning Time	93 msec (random seek)
Transfer Rate	20,000 cps
Communications	
Line Facility	Leased or switched
Line Configuration	Point-to-point
Line Speed	1,200–4,800 bps (sync); 75–1,200 bps (async)
Transmission Mode	TTY or binary sync
Transmission Code	EBCDIC or 8-bit ASCII, LRC or CRC checking
Emulation	IBM 2770, 2780, 3770, 3780; Burroughs BC1000
Peripheral Options	
Card Reader	250 cpm
Printers	Up to 2; 60/120/180 cps, 132 col., 300 lpm
Magnetic Tape	12.5 ips, 8.5-in. reel; 7-track, 800 bpi; 9-track, 800 or 1,600 bpi
Cartridge Tape Drive	5.76 Mb, 60 ips, 3,200 bpi (440)
Compatibility	
Computer System	IBM 360/370; Burroughs (any)
Terminals	IBM 2770, 2780, 3770, 3780; teletypewriters; Burroughs
Control Procedures	IBM bi-sync
First Delivery	First quarter 1976 (440); Fourth quarter 1976 (410)

PERFORMANCE AND COMPETITIVE POSITION

Sycor appears to have aimed the 400 Series at the two major marketplaces where it has been successful with earlier products: the remote data entry market and the intelligent terminal market. The presence of the large sealed disk, however, will bring the 400 series into competition (direct or indirect) with some of the current key-to-disk offerings. The presence of such specialized support functions as report generation, local file inquiry, and sorting will also make these systems competitive as a remote satellite data processor.

Data Dynamics, Inc., the distributor of Sycor systems, will place their marketing emphasis on providing turnkey systems for the manufacturing and distribution markets. New turnkey applications are under development and will be available through Data Dynamics.

With the availability of a front feed device for printing single forms, Sycor is expanding their marketplace to include institutions such as banks, credit unions, and warehouses, where creation of ledger cards, stock certificates, voucher checks, receipts, etc., must be produced on the spot.

All of these markets are sizable and include a number of strong competitors. It appears that Sycor will mainly concentrate on the intelligent data entry marketplace, where it has had considerable success. The most direct competition for the 400 Series will come from the larger Datapoint systems, such as the 2200 and 5500; Sanders 800 Series; Four Phase IV/40 and IV/70 systems; Singer 1503; and entries such as Raytheon PTS/100 and PTS/1200. IBM has aggressively moved into these markets with the 3760 key-to-disk system and other products based on the 3790 communications system.

The 400 Series marks a substantial improvement over the facilities offered by the older Sycor 340/350 systems. Not only can relatively inexpensive display terminals be added as required on the 440 (without the cost of additional processors), but also the availability of a large common data base on the sealed disk will allow for new classes of applications. The Model 410 provides an alternative for users in choosing between the keying capability of stand-alone terminals and the processing power and on-line storage of larger, more sophisticated shared processing systems. Several of the weaknesses of earlier systems have been corrected: the use of TAL II in generating application programs is much simplified over what had been necessary with TAL I; the size of the video display has been enlarged for easier viewing; there is now a feature to suppress (by a single keystroke) the sometimes annoying control characters on the video display; and the command language interpreter has streamlined station operating mode control.

Generation of TAL II programs will probably still require a technical person trained in the principles of TAL II, even though the usability of the TAL language has been greatly improved. Other competitors, such as IBM with the 3760, purport to allow non-programmers to define data entry and validation sequences; the greater capabilities, hence, complexity of TAL II would ordinarily preclude this for the 400 Series. The TAL II generator can run concurrently with data entry operations if the memory is large enough to permit it.

TAL II is one of the richest of the many data entry languages presently available. In addition to the common

functions of field editing, accumulator manipulation, and record construction, it allows a set of I/O operations to perform such functions as keyed file inquiry, record updating, and programmed printing of transaction-based data.

In addition to TAL II, Sycor offers an enhanced subset of ANSI COBOL which allows COBOL programs to control distributed data entry and processing tasks. Both TAL II and COBOL tasks may run concurrently. The addition of BASIC to the software repertoire provides mathematical and problem solving capabilities. The provisions of the support software, combined with the remote file tranfer facilities, report generator, sort, and shared access to files, make the 400 Series interesting candidates for distributed data processing sites.

CONFIGURATION GUIDE

Sycor's 400 Series Processing Systems consist of a microprocessor with system logic and memory, a single fixed disk, either a tape cassette or flexible disk drive, and an alphanumeric display station. Optional equipment includes a card reader, up to two printers (line or serial), cartridge tape drive, up to 64K bytes of memory, extended fixed disk storage, keypunch style keyboard, communications interfaces which may include modems, a magnetic tape unit, and a power fail feature. Figure 1 presents a sample 400 Series configuration.

Communications on the 400 Series enables the sytem to communicate with remote Model 340, 350 or other 400 Series systems using point-to-point IBM 2770 compatible binary synchronous communications over switched or private lines. Remote Job Entry provides communication with a host CPU by emulating IBM or Burroughs protocols.

A basic 440 system consists of a microprocessor control unit with 24K bytes of main memory, a single fixed disk with 5 Mb capacity, at least one typewriter style keyboard/video display station, and either a cassette or flexible disk drive. Up to eight keyboard/video display stations may be attached. The system can optionally be configured with a 10 Mb disk extension; Sycor recently announced the capability to add an additional 10 Mb disk, thereby raising the total fixed disk capacity to 20 Mb. Each display station (usually) operates concurrently with other stations under direction of the control program. The cassette or flexible disk is used primarily for off-line storage, with all programs and most data files being resident on the sealed disk unit.

The Model 410 consists of a microprocessor control unit with 40K bytes of main memory, a single fixed disk with 2.5 Mb capacity, a single typewriter style alphanumeric display station, a cassette, bi-directional 60 cps matrix printer, and binary synchronous communications at up to 4,800 bps. The 410 processes tasks concurrently, thereby allowing data entry and inquiry/response applications to be performed in the foreground while normal processing tasks are performed in the background. The control program provides the capability to perform parameterized data entry editing with numeric, alphabetic or mixed data checks, mandatory field fills, or omissions, as well as right justification, accumulation or subtotaling. The system can optionally be configured with either a 5 Mb or 10 Mb disk extension. A flexible disk may be added in lieu of the standard cassette.

Each alphanumeric display station consists of a 7 x 9½-inch screen containing nine lines of 64 characters and a keyboard with either a standard typewriter or keypunch section, a numeric pad, and a number of special symbols and function keys. The keyboard is used to invoke and control system functions (including concurrent background batch

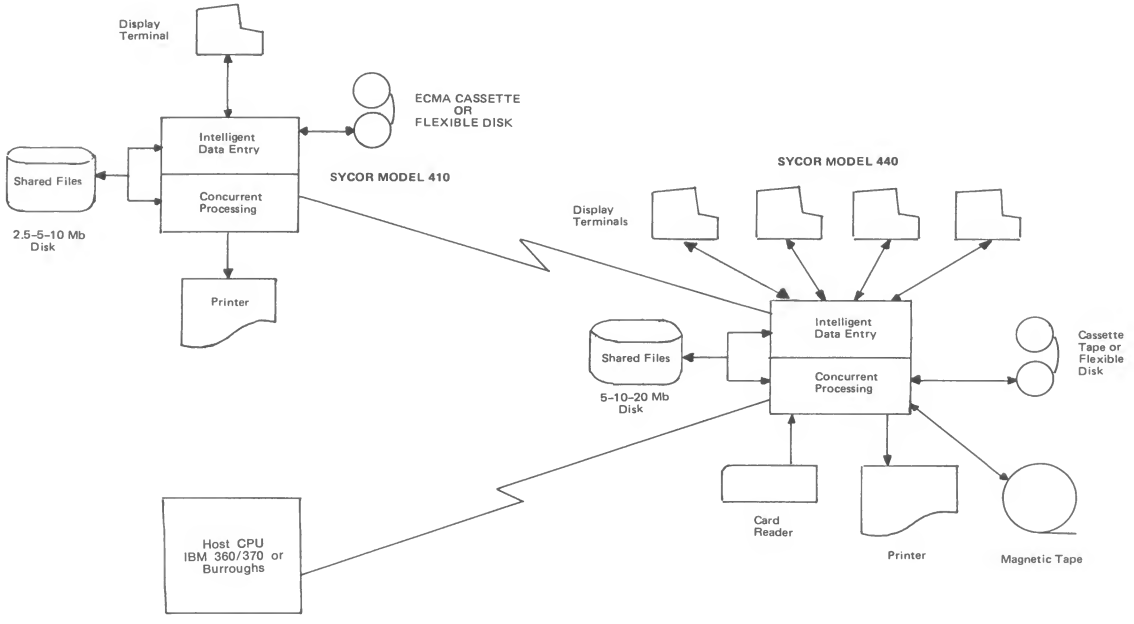


Figure 1. Sycor 400 Series: Sample Configuration

operations) and to enter data. The display screen is used by the control program to prompt the operator and, for data entry tasks, to display format data as well as the entered keystrokes. The top line of the screen is reserved for station status information, with the remaining eight lines used for format prompts and entered data. The format codes associated with each format field may be displayed optionally or suppressed by use of a special format mode key.

The fixed disk contains fixed sector blocks of 512 bytes. Sectors may contain system programs, user programs, or data files. The number of sectors available to the user depends upon the capacity of the fixed disk. Disk file access is made through the control program, which controls space allocation and maintains file directories. The disk support system provides for automatic alternate sector assignment as required.

The cassette drive uses Phillips-type cassettes, with data recording at 800 bits per inch and a maximum capacity of 200,000 characters. Data is recorded with read-after-write checking, with automatic error recovery supported by the system. The flexible disk uses 76 tracks: 73 for data, one for an index, and two for spares. Data is recorded in 128-character sectors, with 26 sectors per track, giving a total flexible disk capacity of 242,944 characters. Access time with no track movement is approximately 100 milliseconds; head positioning time is 2.5 milliseconds per track. The disk rotates at a speed of 360 revolutions per minute for a transfer rate of 20,000 characters per second. The recording medium is an IBM 3740 diskette or equivalent. Both the cassette and the flexible disk are compatible with the media used in the 340 or 350 systems.

A "Guardian" power fail option is offered on the 400 Series to provide user protection regarding the potential problems of power fluctuations, memory failures, and CPU failures. The control unit has an attached battery pack and automatically transfers the data in RAM to the system's fixed disk in the event of a failure, and restores the contents to RAM when power is restored. The cursor on the system's CRT(s) is returned to the last position keyed prior to the disturbance, thereby eliminating the loss of prior data entry.

Optional Peripheral Devices

The Sycor 400 Series Processing Systems may be configured with any of the following:

- Additional alphanumeric display units, up to eight total (440 only).
- Magnetic tape.
- Up to two printers.
- Card reader.
- Cartridge tape (440 only).
- Single form front feed for some printers.
- Tear-bar tractor feed for tear-off applications.
- Synchronous communications.
- Asynchronous communications.

Display stations on the 440 system may be attached either directly (up to 35 feet from the controller) or locally (up to 300 feet from the controller). Typewriter and keypunch type keyboards may be mixed within a single system.

A single ½-inch magnetic tape drive may be attached to the 400 Series systems. Three types of units are offered: 9-track, 800 bits per inch (NRZI); 9-track, 1,600 bits per inch (phase encoded); and 7-track, 800 bits per inch (NRZI). All units operate at 12.5 inches per second, with a rewind speed of 50 inches per second. Reels holding up to 1,200 feet of tape may be used. System software supports compatibility with IBM 9-track odd parity EBCDIC; IBM 7-track even parity BCD; Honeywell, GE, and NCR 7-track odd parity BCD; and NCR 9-track odd parity ASCII.

From one to two printers may be attached to a system, selected from four different units, all with 132 print positions and capable of making up to five copies. The 60, 120, and 180 character per second printers are bi-directional, and make use of 7 x 7 dot matrix characters; the line printer uses a drum and can print at 300 lines per minute. Horizontal and vertical format controls are standard on all printing devices.

An optional card reader inputs 80-column punched cards at a speed of up to 250 cards per minute.

A cartridge tape drive is available for the 440 system which provides users with a simple and inexpensive mode of maintaining back-up information. The unit utilizes standard 3M-type cartridges. Utilities to dump and restore data are provided with the unit.

A front feed device for printing single forms, e.g. ledger cards, stock certificates, voucher checks, etc., is available for some models of Sycor printers. The unit adjusts to accommodate various form sizes, and may be interchanged with the standard tractor feed.

Control of the peripheral devices is usually by means of the data transfer utility, which operates as a background concurrent task.

DATA COMMUNICATIONS

The 400 Series can support two data communications lines. Asynchronous communications may operate from 75 to 1,200 bps point-to-point over private or leased lines. Using the binary synchronous discipline (standard on the Model 410), the 400 Series can emulate an IBM 2770, 2780, 3770, or 3780 operating at 1,200 to 4,800 bits per second. A system utility permits operation as an RJE station as a concurrent task. The systems may be equipped with integral modems and/or an autodial feature to provide automatic calling of stored telephone numbers. Unattended communications programs are also provided.

Sycor's 400 Series systems support the Burroughs Remote Job Entry communications program (BRJE), which operates at speeds of up to 7,200 bits per second, using the standard Burroughs BD1000 line protocol. Any Burroughs host system can communicate with BRJE in either synchronous or asynchronous mode.

SOFTWARE

A considerable amount of software is available with the 400 Series, almost all of which operates in concurrent mode under a station control program. The only software elements that must be run in stand-alone mode are those which require large amounts of memory and those which effectively lock out a peripheral device. These are a system diagnostic set, a disk dump/restore program, and the TAL II generator. While the diagnostics and dump/resotre program should properly be stand-alone facilities, it is not necessary to bring down the entire system to generate a new TAL II application program. In common with many intelligent terminal vendors, Sycor does not release a machine language assembler program. Instead, the firm offers TAL II, a language which can loosely be called a terminal management/data entry language.

The control program interacts with the operator by means of a command language interpreter, which provides more straightforward indications of the available functions than on the earlier 340 system. Simple English keywords are used by the operator to invoke one of the concurrent control functions. To request the execution of a TAL II program, for example, the operator keys a "DE" job control command to specify 340 emulation, then the name of the format program and the name of the file on which it is to operate. In a similar manner the various utility functions may be invoked, including execution of a report generation program, remote transmission of a file to another site, or spooling of a file to cassette, floppy disk, or magnetic tape.

With the availability of TAL II, the 400 Series extends the concept of user programmability of data entry applications, which was introduced by the earlier TAL with the 340. Many of the difficulties of operating in TAL, such as the inability to use statement labels or subroutines, have been moderated while keeping the useful editing facilities of the language. Sycor also provides a translation program to allow users with running TAL programs to convert to TAL II.

TAL II consists of a set of macro statements, associated with data entry fields, files, or working entities defined by the user. A full set of operations is allowed on these fields, including the common data entry functions, such as numeric field validation, zero filling, check digiting, and table lookup. In addition, a set of arithmetic manipulation operators is supported, as well as file lookup and line-by-line printing as transactions are entered. These last two features allow for quite powerful TAL II applications.

A subset of ANSI COBOL is supported on the 400 Series, which provides the user with a powerful batch processing language that supports both data manipulation and data entry operations. In addition to the standard facilities, Sycor's COBOL can interact with the display screen, thereby allowing the creation of COBOL programs which control all data entry requirements. The user can also run both TAL II and COBOL concurrently, with TAL II in the foreground and COBOL in the background, as well as running COBOL in both foreground and background. A debug facility is provided to aid program development. Support is provided for sequential, direct, and indexed file access. The COBOL compiler requires 16.5K bytes of memory.

The addition of BASIC to the software repertoire of the 400 Series introduces a capability normally available through time sharing facilities. BASIC provides the user with a mathematical and problem solving tool. While processing in BASIC, data entry applications can continue to be performed. Support is also provided for both sequential and direct access files.

A rather comprehensive set of utility functions are also available by invocation from the command processor. These functions include a Sort program; sequential, random, and indexed file creation; control of file access characteristics; task status and disk file display; file copying from one device to another; disk file reblocking; text editing; file transmission; dynamic reconfiguration of memory structure and resident software; and a construct utility to re-initialize and restore all system files from a "cold start".

Sycor's 400 Series systems can act as a master station for transmitting data to and receiving files from unattended remote Model 340, 350 or other 400 Series systems using point-to-point IBM 2770 compatible binary synchronous communications over switched or private lines. Communications may also be handled under direct CPU control using IBM 2770, 2780, 3770 or 3780 under BTAM, TCAM, POWER, HASP, and GRASP or Burroughs BD1000 communications protocols. These capabilities provide the user with control of network communications without the need for conventional front-end processing and CPU support.

MAINTENANCE

Sycor has over 90 service centers in the United States and Canada. Secondary population centers are serviced by Sorbus, a subsidiary of MAI.

Each system automatically cycles through a diagnostic procedure upon being powered on; a set of disk-resident system and component diagnostics is provided with each system.

PRICE DATA

Description	Lease (Incl Maint) 12 Mo. $	Lease (Incl Maint) 42 Mo. $	Purchase Price $
440 System (Control Unit with: 5Mb disk; 24K memory; display control unit for 1–4 display stations)	454	385	14,865
410 System (Control Unit with: 2.5MB disk; 40K memory; ECMA cassette; display station; synchronous communications; 60 cps printer)	600	506	25,230
410 System with 120 cps printer	675	576	26,270
410 System with 180 cps printer	745	629	28,250
410 System with 300 lpm printer	845	711	32,030

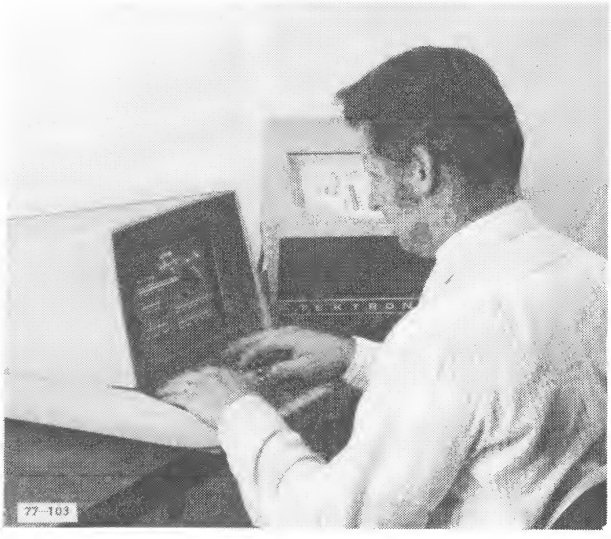
PRICE DATA (Cont.)

Description	Lease (Incl Maint) 12 Mo. $	Lease (Incl Maint) 42 Mo. $	Purchase Price $
Display (control unit powered, typewriter or keypunch keyboard)(1)	44	37	1,800
Display (local powered, typewriter or keypunch keyboard)(1)	50	42	2,000
Display Control Unit for 5–8 Displays	20	17	730
8K Memory Module(2)	33	27	1,440
2.5 Mb Disk Extension(3)	50	41	2,250
5 Mb Disk Extension(3)	100	82	4,500
10 Mb Disk Extension(3)	230	190	9,000
Flexible Disk Controller	70	59	2,755
Cassette Controller(4)	46	39	1,805
Flexible Disk in lieu of ECMA Cassette(5)	24	19	950
Synchronous communications controller (1200 bps USASCII) with 202C compatible modem	64	55	1,900
Synchronous communications controller (2400 bps USASCII) with 201C compatible modem	92	78	2,900
Synchronous communications controller (3600/4800 bps USASCII)	37	32	1,100
Asynchronous communications controller (110–1200 baud USASCII) with 202C compatible modem	53	45	1,600
EBCDIC Feature	N/C	N/C	N/C
Card Reader (250 cpm)	122	102	3,500
9-Track Magnetic Tape Drive (1,600 bpi)(3)	395	336	11,800
7- or 9-Track Magnetic Tape Drive (800 bpi)(3)	215	179	7,200
Cartridge Tape Drive(7)	91		3,500
Auto Dial Option	30	26	800
Guardian Power Fail Option	62	54	2,200
60 cps Bi-Directional Matrix Printer(8)	155	133	5,600
120 cps Bi-Directional Matrix Printer(8)	218	190	6,600
180 cps Bi-Directional Matrix Printer(8)	276	242	8,620
300 lpm Line Printer	470	405	16,300
Single Form, Front Feed	35–50		800–1,200
Tri-Intensity Option	10	9	500
202C Compatible Sycor Modem	32	27	1,000
201B/C Compatible Sycor Modem	60	50	2,000
6/8 Lines per Inch Option	35	29	1,400
Internal/External Clocking Switch	NA	NA	200
ASCII/EBCDIC Switch	NA	NA	200
BASIC Software			750

Notes:
(1) Four maximum per system (440 only).
(2) Five maximum per 440 system; three maximum per 410 system.
(3) Maximum of one.
(4) A system cannot have a cassette controller and a flexible disk controller.
(5) 410 system only.
(6) Either asynchronous or card reader but not both; maximum of one.
(7) 440 system only.
(8) Only two matrix printers per system.

TEKTRONIX INC.

4006 and 4010 Series Graphic Display Terminals



OVERVIEW

The 4006 and 4010 series terminals represent Tektronix' two major product lines of Direct View Storage Tube (DVST) graphic display terminals. In addition to being able to function as conventional alphanumeric display terminals, these units can also display symbols, charts, or any graphic images that can be constructed as a series of line segments within the display screen's implied X,Y coordinate grid. However, unlike more expensive refreshed graphic displays, these terminals do not permit selective erasure or modification of a screen image; a line segment, once drawn, cannot be erased without erasing the entire screen.

This feature does make Tektronix' DVST terminals inappropriate for any applications that require dynamic, rapidly changing display images, such as flight simulation or real-time monitoring applications. Otherwise, these terminals possess all the hardware features and software support necessary to develop virtually any computer graphics applications.

The 4006 Computer Display Terminal represents the lowest cost DVST terminal now on the market. It is similar to the other models in Tektronix' 4010 series except that it has a somewhat smaller, 7.5- by 5.6-inch display screen and does not include a manually controlled cross-hair cursor for graphic input operations. The 4010 series itself comprises five major model types:

- 4010. This model features an 8.25- by 6.38-inch display screen; a 63-character, uppercase-only ASCII character set; and a 1,024 by 1,024 addressable coordinate grid.
- 4012. This model is comparable to the 4010 except that it can generate the full 96-character upper/lowercase ASCII character set. Also, the 4012 utilizes a 7&9 dot matrix for character display, instead of the 4010's 5&7 matrix.
- 4013. This model is identical to the 4012 except that it includes control logic for handling APL as well as ASCII character sets.
- 4014. This model offers a very large, 15- by 11-inch display area and an optional Enhanced Graphics Module that permits screen resolution to be expanded from the normal 1,024 by 1,024 addressable grid to a 4,096 by 4,096 addressable coordinate grid.
- 4015. This model is identical to the 4014 except that it includes control logic for handling APL as well as ASCII character sets.

A full range of Tektronix-developed functional software packages, collectively known as PLOT-10 software, is available for the 4006 and 4010 series terminals. Tektronix also markets a wide variety of peripherals for these terminals, including cartridge tape and diskette auxiliary storage units, electrostatic copiers for reproducing display screen images, and graphic tablets for input of graphic information. The company has also recently introduced two new microprocessor-based products that possess capabilities over and above their current DVST terminals. These products — the 4051 and 4081 Graphic Display Systems — can both function as terminals or as complete, stand-alone computer graphics systems, capable of being programmed in BASIC. The 4081, the more powerful of the two products, can support both DVST and refreshed graphics, while the 4051 supports only DVST graphics.

Other display-related products currently being marketed by Tektronix include the 4023, a low-cost alphanumeric display terminal that can also display horizontal and vertical line segments, and the 4002A, a DVST terminal similar to the 4010, which is no longer being manufactured but is still marketed on an "as-available" basis.

Tektronix itself is a diversified company that manufactures oscilloscopes, electronic test equipment, and medical and scientific instrumentation in addition to graphic displays. About one-sixth of the company's $300+ million annual

HEADQUARTERS

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Information Display Division
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(503) 292–2611

revenues are currently derived from display products and associated peripherals and software. The company has more than 45 sales and service offices in the United States as well as an extensive network of foreign subsidiaries and distributors.

PERFORMANCE AND COMPETITIVE POSITION

At present, Tektronix might well be classified as the only true "mass marketer" of graphic display terminals. The company is clearly the dominant manufacturer of direct view storage tube terminals. In fact, most of Tektronix' competitors in the DVST market utilize Tektronix' display tubes as the basis for their own products. And DVST terminals themselves far outnumber the more powerful but far more expensive dynamically refreshed graphic displays.

Certain display technologies now being employed on an experimental basis in the graphics field — such as plasma displays or pixel displays — could eventually usurp the DVST's position in the graphics marketplace. The first commercial graphics plasma display in the mass-marketable range is the Magnavox Orion-60 (see intelligent terminals section). But for the next several years at least, DVSTs should remain the lowest-cost, most widely used means of implementing display graphics.

Hardcopy plotters, of course, represent another low-cost alternative for obtaining graphic output. Drum plotters and DVST terminals fall in the same general $3,000–$10,000+ price range, and both can function on a local or remote basis. However, there are certain fairly well-defined application characteristics that tend to dictate the choices between a plotter and a graphic display. These are:

- *Amount and accuracy of hardcopy output.* A hardcopy plotter is generally a more natural choice if all graphic output must be in hardcopy form. While DVST terminals can be configured with auxiliary electrostatic copiers that reproduce screen images, these copiers are just as expensive as most plotters. In addition, they are relatively slow (10 seconds or more per copy), and they cannot provide the high, thousandths-of-an-inch accuracy available with most drum and flatbed plotters.
- *Degree of interaction required.* A plotter may also be a more appropriate choice than a display if real-time interaction is not required. Most plotters may be configured with fairly inexpensive off-line controllers that can accept magnetic tape input, thereby obviating much of the CPU time and line costs associated with an on-line terminal. On the other hand, a display terminal is generally preferable in situations where fast turnaround is required, since a display terminal itself will generally be far less expensive than a plotter/keyboard-terminal combination.

  As was pointed out earlier, however, a DVST-based terminal is limited in its interactive capability in that display images cannot readily be modified. If the application is such that images must be modified or changed more frequently than, say, every 5 or 10 seconds, then a refreshed graphic display will be a more appropriate choice than a DVST terminal.

Hardcopy plotters and refreshed displays aside, Tektronix competitors in the DVST market include Hughes, Computek, Ramtek, Aydin Controls, and Princeton Electronic Products, among others. Sanders and Adage also market DVST terminals, although these are used primarily as auxiliary displays to these companies' own refreshed display systems. Hughes' displays are particularly interesting in that display commands are based on polar coordinates rather than the familiar X, Y coordinate structure. This feature can substantially reduce the amount of data that must be transmitted to form a display image, particularly if the image consists of a large number of curved surfaces.

SYSTEM DESIGN

All six models in Tektronix 4006/4010 series include a DVST, keyboard, control logic, and communications interface as standard features, all housed in one desktop-sized chassis. Key specifications for each of the six model types are shown in Table 1.

Aside from the differentiations in price, screen size, resolution, and character sets noted in Table 1, 4006/4010 models are also differentiated by the presence or absence of an integral interface for the Tektronix 4631 Hard-Copy Unit. The 4006, 4010, 4014, and 4015 can be configured with this interface, but only if it is ordered with the terminal. Models without the interface receive no submodel designation, while those with the interface are indicated by a "dash one" after the model type (e.g., 4006–1). The 4012 and 4013 cannot be configured with this interface, and hence cannot support the 4631. However, both the 4012 and 4013 are available in ruggedized, rack-mounted versions designated the R4012 and R4013, respectively.

PERIPHERALS

Some of the more commonly used peripherals available with 4006 and 4010 series terminals include:

4631 Hard Copy Unit. The 4631 provides permanent, 8-½– by 11–inch electrostatic copies of any information on the display screen. The unit is activated by a manual pushbutton control and takes 18 seconds to produce the first copy and 10 seconds for each additional copy. Up to four terminals may share a single 4631 unit.

4923 Digital Cartridge Tape Recorder. The 4923 can be used to record computer/terminal dialog or to prepare data off-line for subsequent on-line batch transmission. Data is stored on a removable tape cartridge which can store up to 200K bytes of information. However, since the 4923 employs a unique recording scheme, tape output cannot be read by any device except a 4923.

4921/4922 Flexible Disk Memories. These units possess capabilities similar to those of the 4923 Digital Cartridge Tape Recorder, except that data is stored on flexible disks, each with a capacity of 262K bytes. The 4921 is a single-drive unit, while the 4922 possesses two drives. Both model types employ a "read-after-write" feature which helps reduce bit error rates to less than one per one hundred million.

4953/4954 Graphic Tablets. These devices enable

Table 1. Tektronix Graphic Display Terminals: Specifications

MODEL TYPE	4006	4010	4012	4013	4014	4015
Display Screen						
Width (in.)	7.5	8.25	8.25	8.25	15.0	15.0
Height (in.)	5.6	6.38	6.38	6.38	11.0	11.0
Viewable Raster	1,024 x 1,024	1,024 x 1,024	1,024 x 1,024	1,024 x 1,024	4,096 x 4,096	4,096 x 4,096
Addressable Raster	1,024 x 780	1,024 x 780	1,024 x 780	1,024 x 780	4,096 x 3,120	4,096 x 3,120
Vector Drawing Time (MS)	3.6	2.6	2.6	2.6	2.6	2.6
Character Generation						
Char Set	ASCII	ASCII	ASCII	ASCII; APL	ASCII	ASCII; APL
No. of Displayable Chars	63	63	96	96; 88	96	96; 88
Matrix Pattern	5 x 7	5 x 7	7 x 9	7 x 9	7 x 9	7 x 9
Max No. of Lines	35	35	35	35	70	70
Max Char/Line	74	74	74	74	122	122
Max Char/Display	2,590	2,590	2,590	2,590	8,512	8,512
Operating Modes						
Alphanumeric	Yes	Yes	Yes	Yes	Yes	Yes
Graphic Input	No	Yes	Yes	Yes	Yes	Yes
Graphic Display	Yes	Yes	Yes	Yes	Yes	Yes
Remarks					Includes Discrete-Plot Mode: Dot/Dash Vectors	Includes Discrete-Plot Mode: Dot/Dash Vectors
Data Transmission						
Line Facility	Narrowband; voicegrade; cable	Narrowband; voicegrade; cable	Narrowband; voicegrade; cable	Narrowband; voicegrade; cable	Narrowband; voicegrade; cable	Narrowband; voicegrade; cable
Line Speed (bps)	75–4,800	75–9,600	75–9,600	75–9,600	75–9,600	75–9,600
Line Mode	HDX/FDX	HDX/FDX	HDX/FDX	HDX/FDX	HDX/FDX	HDX/FDX
Line Code	ASCII	ASCII; others	ASCII; others	ASCII; others	ASCII; others	ASCII; others
Synchronization	Async	Sync/Async	Sync/Async	Sync/Async	Sync/Async	Sync/Async
Base Purchase Price ($)	2,995	4,195	5,595	5,795	9,595	9,995

rapid, accurate input of vectors or points through movement of a hand-held pen or pushbutton cursor over the tablet surface. The 4953 provides an 11- by 11-inch tablet surface area, while the 4954 provides a much larger, 40- by 30-inch surface area.

Key optional features available with 4006/4010 series terminals include (1) alternate communications interfaces in addition to or in place of the standard RS-232-C communications interface (see COMPATIBILITY, herein), (2) an option that allows a terminal to function off-line as an electronic calculator, (3) a joystick, which permits easier manipulation of the input cursor than do the standard thumbwheel controls, and (4) various special-purpose I/O interfaces for audio recorders, slave displays, and sensor-based devices.

SOFTWARE

Tektronix provides a full range of functional and system software routines for the 4006 and 4010 series terminals, collectively known as PLOT-10 software. While none of these routines form a complete, application-specific software package, they do provide most of the basic software building blocks needed to develop a graphics application, such as axis labeling and scaling or interfacing the terminal to a host computer operating system. One very popular PLOT-10 routine also enables graphic input to be accepted in a format identical to that used for Calcomp plotters, thereby permitting plotter output to be previewed on the display before final hardcopy output is produced.

Most PLOT-10 software is supplied in the form of parameter-driven, host-resident FORTRAN subroutines which may be used on any computer with a standard FORTRAN compiler. Special assembler language versions have also been written for implementation under IBM's TSO and for implementation with popular minicomputer systems such as the Data General Nova, H-P 2100, Varian 620, and DEC PDP-8 and PDP-11 series. All PLOT-10 software is unbundled and can be obtained from Tektronix only on a purchase basis.

COMPATIBILITY

The standard RS-232-C data communications interface for the 4006 and 4010 series terminals provides for full-duplex asynchronous transmission using the standard 10-unit ASCII code structure. Transmit and receive rates are independently switch-selectable from 75 to 9,600 bps (4,800 bps on the 4006). Local echo and parity generation are also switch-selectable on most models. This interface permits communications over switched, leased, or private point-to-point voicegrade lines when used with an appropriate Bell 103 or 202 series external modem.

Tektronix also offers a wide variety of optional communications interfaces, enabling terminals to communicate with virtually any type of computer system. These optional interfaces include half-duplex interfaces, synchronous interfaces for communications with CDC 6000 series computers, and interfaces for direct cable connection to a variety of minicomputers. If necessary, a terminal may be configured with two independent, switch-selectable communications interfaces.

On a software level, Tektronix terminals may be used with any computer system supporting ASCII, ASCII/APL, or

IBM Correspondence Code. In alphanumeric mode using ASCII code, the terminals function as Teletype Model 33 or Model 35 teleprinters and require no software modifications when used with existing TTY 33/35 applications programs. In their graphic modes, the terminals will require specialized support routines which may be developed by the user but more typically are purchased from Tektronix.

MAINTENANCE

The standard Tektronix maintenance contract, included with all leased equipment, provides for on-call service during 8 prime-shift hours of each normal working day, weekends and holidays excluded. The fixed monthly rate for this contract covers all expenses for parts, labor, and travel, provided the user's site lies within a 100-mile radius of the nearest Tektronix service center. Any site outside a 100-mile radius will be subject to an additional charge of at least $50 per month. Off-shift or weekend coverage can also be arranged through most Tektronix service centers for an additional monthly fee.

Users with purchased equipment have the option of obtaining a standard maintenance contract or paying for maintenance on a per-call, time-and-material basis. In either case, users with purchased equipment need not obtain a maintenance contract until at least 90 days after equipment installation, since any trouble occurring during this period will be fixed free-of-charge under the terms of Tektronix' comprehensive new equipment warranties. In addition, most Tektronix' equipment is warranted against defective materials for up to 1 full year after installation; parts needing repair or replacement will be furnished free-of-charge during this period.

Tektronix currently has over 40 field service offices throughout the United States. The company also maintains an expanding network of overseas sales and service organizations, most of which are controlled through the Tektronix overseas headquarters in Badhoevedorp, Holland.

PRICE DATA

Prices for key 4006 and 4010 series terminals, options, and peripherals are shown in the following. Interested parties should contact Tektronix for exact prices on any terminal configuration, since the list here does not include prices for certain accessories and peripheral interfaces and options. All prices shown are F.O.B., Beaverton, Oregon.

PRICE DATA (CONTD.)

Description	Purchase Price $	Lease (1 Yr) (Incl. Maint.) $/Mo.	Monthly Maint. $
Terminals			
4006-1 Computer Display Terminal	2,995	180	37
4010 Computer Display Terminal	4,450	265	40
4010-1 Computer Display Terminal	4,950	295	40
4012 Computer Display Terminal	6,350	380	45
R4012 Computer Display Terminal	6,750	405	45
4013 Computer Display Terminal	6,850	410	50
R4013 Computer Display Terminal	7,250	435	50
4014 Computer Display Terminal	11,250	675	85
4014-1 Computer Display Terminal	11,650	700	85
4015 Computer Display Terminal	12,250	735	85
4015-1 Computer Display Terminal	12,700	760	85
Options			
Standard RS-232-C Communications Interface	NC	NC	NC
Optional Async Data Communications Interface (all types)	400	24	4
CDC 6000 Series Sync Data Communications Interface	2,995	180	25
2741 Correspondence Code Interface	895	54	15
W/additional 2K of memory	1,145	69	17
Enhanced Graphics Module (4014/15 only)	750	45	7
Pedestal (4006 only)	145	6	NA
Peripherals			
4631 Hard-Copy Unit	4,295	255	50
4911 Punch Tape Reader/ Perforator	3,695	220	20
4921 Flexible Disk Memory	3,995	240	40
4922 Dual Flexible Disk Memory	6,355	380	50
4923 Digital Cartridge Tape Recorder	1,995	120	13
4953 Graphic Tablet (11" x 11")	3,195	190	20
4954 Graphic Tablet (40" x 30")	5,295	320	30

NC — No Charge
NA— Not Available

TEKTRONIX INC
4081 Interactive Graphics System

OVERVIEW

The Tektronix 4081 Interactive Graphics System is an intelligent graphics display system based on a dedicated minicomputer. It has been designed to operate as a standalone system or as an intelligent terminal relying on a host computer.

The 4081 marks a break with the historical reliance of Tektronix on its storage display tubes as graphic display devices. The 4081 combines both high-resolution storage tube electronics and the more conventional refresh graphics display into a single display screen through the use of a display controller. The storage tube electronics allows the display of large amounts of graphic and alphanumeric information without flicker, and the refresh graphics allows movable, dynamic pictures to be displayed.

The 4081 consists of a 19-inch display screen, display controller, a minicomputer with 32K bytes of memory, an alphanumeric keyboard with joyswitch, a cartridge magnetic tape drive, asynchronous communications interface, and real-time clock. Included in the basic 4081 package is system software — a Graphic Operating System (GOS), an Interactive Graphic Terminal (IGT) package, and a Tektronix 4014 emulator. Because Tektronix has placed initial emphasis on graphic program development at the host computer, the IGT package has been designed to facilitate the operation of the 4081 as an intelligent terminal. Optionally, the system can be configured with additional cartridge tape drives, flexible disk drives, cartridge disk drives, line printers, plotters, and screen hard copy units.

HEADQUARTERS
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Information Display Group
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Beaverton OR 97005
(503) 644-0161

For a number of years Tektronix has been building and marketing its storage tube graphic terminals as the 4000 Graphic Terminal Series. The most recent addition to the Tektronix line of terminals is the 4051 Graphic Computing System. Like the 4081, the 4051 is a new departure for Tektronix; it is a microprocessor-based storage tube display with a firmware BASIC interpreter. The 4051 is a desktop unit aimed at the time-sharing, supercalculator, and direct instrument control markets. For a full analysis of the Tektronix 4051 see AUERBACH report 155.6448.500.

The Tektronix 4081 was announced in May 1976. System specifications are listed in Table 1.

COMPATIBILITY

The Tektronix 4081, as a new product type with a dedicated operating system, has no direct processor compatibility with other computers. Tektronix furnishes host machine software compatibility in the form of FORTRAN routines (source card deck) that provides access to the IGT package resident in the 4081. Emulation of the Tektronix 4014 Computer Graphics Terminal is standard.

PERFORMANCE AND COMPETITIVE POSITION

Over the years, Tektronix has been active in the graphic terminal system market, with the 4000 Graphic Terminal Series as the major product. With the announcement of the 4051 Graphic Computer System, Tektronix began to branch out to a new level of graphic power; it put local programming capability at the remote graphic display itself, thus allowing both off-line and stand-alone graphic system operation. The increased processing power of the 4081 represents Tektronix's further commitment to user programmability for its terminal devices.

The Tektronix 4081 is a powerful and versatile stand-alone graphics processor designed "from the ground up" to be a low-cost, high-performance system. The unique combination of storage tube and refresh graphic hardware allows users to take advantage of two kinds of graphing techniques — fixed screen elements may be written via the storage tube electronics and variable information may be continually displayed "in motion" via the refresh electronics. By combining the two technologies, Tektronix has produced a system with high graphic throughput rates at modest costs.

The emphasis of the initial 4081 announcement has been placed on its ability to operate in conjunction with a host computer. Graphic data can be developed at the host site and then sent to the 4081 for graphic manipulation and display. The local system is capable of performing a number of important graphic functions, including picture transformation, hard copy production, and data reduction or expansion. Clipping, rotation, and windowing of the data stream is under the control of simple operator commands.

Table 1. Tektronix 4081 System: Specifications

Central Processor	
Type	16-bit minicomputer
Instructions	104
Interrupt levels	8
DMA channels	8
Memory type	MOS, 1-microsec cycle time
Memory size	32 to 64K bytes
Display	
Screen size	19 in. diagonal
Display points	2,048 by 1,536
Resolution	Better than 16 line pairs/cm
Beam intensities	4
Graphic write rate	54,000 vector-centimeters/sec refresh; (13,500 vector-centimeters/sec storage)
Keyboard	
Type	Typewriter
Function keys	12
Status lights	4
Joyswitch	Standard w/terminator
Cartridge Tape	
Number of units	1 standard, 2 maximum
Cartridge type	Standard 3M cartridge
Storage capacity	256K bytes
Transfer rate	5,000 bytes/sec
Standard Communications Interface	
Type	Asynchronous
Speed	110 to 4,800 baud
Flexible Disk	
Max number of units	4
Capacity per disk	256K bytes
Random access time	0.275 sec
Transfer rate	31,000 bytes/sec
Transfer mechanism	DMA
Cartridge Disk	
Max number of units	2
Capacity per disk	10 megabytes
Random access time	38 millisec
Transfer rate	310K bytes/sec
Transfer mechanism	DMA
Other	
Line printer	Optional, 132 column, 180 cps, 96 characters
Screen hard copy unit	Optional
Interactive digital plotter	Optional, 10 by 15 inches
Graphic tablet	Optional, 11 by 11 inches, or 40 x 30 inches
Programmer hexadecimal display panel	Optional
Real time clock	Standard
Power failure protection	Optional

The 4081 enters an arena with a large number of programmable graphics processors, all of which use various minicomputers as adjuncts to the screen display electronics. Most vendors of this class of equipment make use of purchased general-purpose minicomputers (as does the 4081, with an Interdata internal processor); only a minority use a programmable processor of their own design. CDC and Digital Equipment are two full line vendors who offer this class of equipment. Sanders, Imlac, Vector General and Information Displays are among those who also offer programmable graphic units.

The price range for minicomputer-based programmable graphic units runs from under $10,000 to over $100,000. The higher priced units typically offer larger addressable display areas, faster display rates, or specialized functions, such as three dimensional software. The 4081, with a base price of $27,000, is somewhere toward the low end of the price scale. The Imlac graphic computers are less expensive, and the Sanders and DEC equipment are slightly more expensive.

SYSTEM DESIGN

The standard Tektronix 4081 consists of a central processor with 32K bytes of memory, a 19-inch display screen with both storage and refresh capability, a display controller, an alphanumeric keyboard with joyswitch, a single-cartridge magnetic tape with 250K-byte capacity (3M data cartridge), real-time clock, asynchronous communication interface, and the Graphic Operating System (GOS) software. To this may be added: an additional 32K bytes of memory, an additional cartridge tape drive, up to four flexible disk drives, up to two 10 megabytes of cartridge disk, a graphic tablet, a line printer, a hard copy unit, an interactive digital plotter, a power failure protection unit, and a hexadecimal display panel.

Central Processor

The central processor is a 16-bit minicomputer with a 1-microsecond MOS memory. Standard main memory size is 32K bytes; 64K bytes is maximum. The processor has 16 general-purpose registers, with a register-to-register add time of 1.5 microseconds. There are 104 instructions in the machine repertoire. The processor has eight interrupt levels and eight I/O ports, all of which operate using the direct memory access (DMA) channel.

Display

The 4081 display consists of a 19-inch screen which is driven by its own display processor. The display consists of 2048 by 1536 displayable raster points, with resolution better than 16 lines per centimeter. Refresh graphics may be generated at a rate of 54,000 vector-centimeters per second, and storage graphics may be generated at a rate of 13,500 vector-centimeters per second. The screen display is flicker free up to either 1600 vector-centimeters or 800 vectors. Vectors are generated using analog point-to-point electronics with four selectable intensities. Erase time for the storage tube portion of the display is nominally 1 second. The display processor can maintain graphic parameters such as window, rotation, and clipping data, thus freeing the central processor of these calculations.

PERIPHERALS

Tektronix offers a variety of standard peripherals as well as specialized peripherals for graphic output.

Cartridge Tape

One 3M-type cartridge drive is standard with the 4081 system, and a second drive is optional. Each drive can hold 256K bytes of data, and a tape can be formatted as a file device or may be used for system initial program load. Transfer rate for the tape cartridge is 5,000 bps. Record-by-record rewrite is supported.

Flexible Disk

Up to four flexible disks may be optionally attached to the 4081. Each disk contains 77 tracks of 16 sectors per track, with a sector holding 256 bytes. Average random access time is 275 milliseconds, and data transfer rate is 31K bytes per second using the processor DMA channel.

Cartridge Disk

A maximum of two cartridge disks may be optionally attached to the 4081. Each disk contains 10 megabytes of data on two platters, one fixed and one removable. Random access time is 38 milliseconds average, and data transfer rate is 310K bps using the DMA channel.

Printer

A 132-column matrix printer which operates at 180 cps may be attached. The printer has a 96-character print set.

DATA COMMUNICATIONS

The 4081 is equipped with an asynchronous communications interface. Transmission speeds from 110 to 4800 baud are supported. Full transmission, local or remote echoing and parity selection, and line speed may be selected by operator keyboard command.

The standard mode of usage of the 4081 in a communications environment is through the Intelligent Graphic Terminal (IGT) package provided with each system. With this package, a host computer with suitable support programs can perform a large number of sophisticated operations at the 4081:

- Files may be created or deleted or their attributes modified.
- File transfers to or from the host and the 4081 media devices may be executed.
- Displays may be called to the 4081 screen from the media or from the host. Graphic parameters (viewport, rotation, etc.) may be specified by the host.
- The 4081 operator input devices (keyboard, joyswitch) may be read by the host.

The host computer's access to the IGT package is through a set of FORTRAN-callable routines resident

in the host. IGT also provides automatic checksum error detection and data retransmission within the asynchronous protocol.

A 4014 emulator is provided for users with host applications which support the Tektronix 4014 Graphics Terminal. The emulator allows the 4081 to operate as a 4014 terminal equipped with the Tektronix Enhanced Graphics Module option.

SOFTWARE

The Tektronix 4081 offers as standard features Graphic Operating System (GOS), an Interactive Graphic Terminal (IGT) package on both the 4081 and host computer, a Tektronix 4014 emulator, and utilities and hardware verification. Optional software modules are also available: a macro assembler, linking loader, text editor, and debugging systems. Tektronix has announced the 4081 resident version of FORTRAN for release in 1976.

GOS is a user-oriented operating system for managing system resources such as programs and peripherals. Via the keyboard, command entry is done under operating system control. GOS uses a concept of "graphic device independence," so that the user may deal with the concept of his picture, with details of display left to the system.

A Graphic Transform Package (GTP), which is part of GOS, provides a full set of picture transformations for the user, including clipping, rotation, scaling, windowing, and picture segment control. GTP also provides a set of interfaces to control all system devices, including media (and files), communications, and entry devices (keyboard, joyswitch, digitizer tablet).

GOS may operate either in stand-alone mode or linked to a host computer. For host operations, IGT or the 4014 emulator is used; in stand-alone operation, the user works through the GOS utilities and development tools.

MAINTENANCE

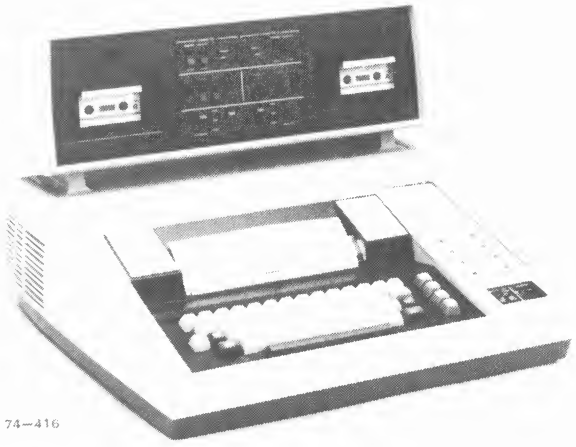
Tektronix services the 4081 system through the same large network of service centers used for their other information display products. There are over 50 such centers in the U.S. and Canada. Service representatives usually restore system operation in no more than 24 hours after placement of a service call.

PRICE DATA

Model No.	Description	Purchase Price (Maint. not Incl) $	Monthly Rental (Incl. Maint.) $ 12 Month	Monthly Maint. $
4081	Graphics System, includes 19-in. display, display controller, computer, 32K-byte memory with parity, 3M cartridge tape drive with 250K-byte capacity, ASCII keyboard, 12 function keys, 4 status lights, RS-232-C interface with program control of baud rate (110–4,800 baud) and parity, integrated into desk, Graphic Operating System (GOS), 4014 emulator, Intelligent Graphic Terminal (IGT) software, utilities diagnostics, demonstration software manuals and installation	27,000	1,755	310
Option 22	64K-byte total memory; 32K-byte additional RAM memory with parity	3,950	257	25
Option 31	Expansion package; additional power supply, secondary backplane with eight full-card slots. Mounts in 4081 desk	1,800	117	18
Option 33	Second digital cartridge tape drive; 3M tape cartridge with 250K-byte capacity, 30-ips drive	2,495	162	18
4905	Mass storage module; coordinated auxiliary cabinet for mass storage peripherals	600	39	3
Option 31	Dual flexible disk; 500K-byte total capacity, 4081 type interface, cable	5,400	351	50
Option 32	Two dual flexible disks; 1-megabyte total capacity, 4081 type interface, cable	10,800	702	100
Option 33	Single hard disk; 10-megabyte total capacity, one fixed, one removable disk; 4081 type interface, cable	12,000	780	140
Option 34	Dual hard disk; 20-megabyte total capacity, 4081 type interface, cable	21,000	1,365	240
4641	(With Option 30 printer) 132 column, 96 characters, 180 character per second, 5 copies, pedestal, integrated power supply 115V, 60 Hz, 4081 type interface, cable	4,315	260	52
4662	(With Option 30 interactive digital plotter) Digitally stepped X-Y plotter/digitizer with a 10 x 15 in. work area. Resolution is within 0.005 in. Plotting rate is 16 in. per second after approximately 100 ms. Pen rate is 10 points per second. Includes alphanumeric character generator, auto scaling and one degree character rotation, absolute addressing, and joyswitch for digitizing 4081 type interface, cable	4,495	270	46
4953	(With Option 30 graphic tablet) 11 x 11 in., 4081 type interface, cable	3,695	220	26
4954	(With Option 30 graphic tablet) 40 x 30 in., 4081 type interface, cable	5,795	350	36
4080A01	Programming support package; MACRO assembler, editor, linking loader, debug, manuals. Manuals on use of Graphic Operation System	3,000	NA	NA
4080A02	FORTRAN IV; compiler (requires 4080A01)	1,500	NA	NA

NA — Not applicable

TEXAS INSTRUMENTS
742 Programmable Terminal



OVERVIEW

The Texas Instruments Model 742 Programmable Terminal is an intelligent terminal designed for data entry, data communications, remote data capture and data manipulation. It is a non-display oriented, compact, desk-top unit. The 742 can be used as a single station terminal or configured in multidrop configurations.

The 742 comprises a 30-cps, nonimpact, dot matrix printer, two cassette drives, a microprocessor with 8K-bytes of read-only memory (ROM), and 2K-bytes of random access memory (RAM). Half-duplex ASCII communications at 110, 150, 300, and 1,200 baud and full-duplex operation at speeds of up to 300 baud can be accommodated using blocked or unblocked protocols. Options include an EIA interface for attaching a peripheral device such as an impact printer or magnetic tape unit, or an internal Bell 202-compatible modem.

The 742 is programmed in TICOL, Texas Instruments' Cassette Operating Language. There are two levels of TICOL; TICOL I is the standard programming language, and TICOL II is designed for more complicated programs. The terminal's Cassette Operating System (COS) is microprogrammed; the TICOL Generator, Lister, Editor, and Translator are supplied on a cassette.

Texas Instruments offers 742 users a Terminal Polling System (TPS). Model 700 TPS is configured with a TI 960 B minicomputer with 24K words (48K bytes), a nine-track tape drive, an operator's console (TI Model 733 ASR), and a 1,200-bps modem. The 700 TPS can provide unattended polling for up to 200 Model 742 terminals. It collects data from the 742s' tape cassettes and records it on a magnetic tape drive (37.5 ips) for further processing.

Table 1 lists the 742 system specifications.

Table 1. Texas Instruments 742: Specifications

Processor	
Main memory (bytes)	8K ROM, 2K RAM
Word length (bits)	8
Addressable registers	8
Program languages	TICOL
Max no. of I/O devices	2 cassette drives, 1 printer, transmission line, 1 opt EIA-compatible peripheral
Auxiliary Storage	
Storage medium	Cassette
Capacity (bytes)	288K/cassette
Transfer rate (cps)	200
Keyboard Entry	
Console layout	Teletype
Code generated	ASCII
Console Printer	
Char set	68 printable, 97 total
Max char/line	80
Rated speed (cps)	30
CRT display	None
Peripherals	1 Centronics 300 or 500 Series impact printer; 1 magnetic tape drive (800 or 1,600 bpi)
Communications	
Line facility	Half-duplex std (full-duplex up to 300 baud)
Transmission code	ASCII
Data rate (bps)	110, 150, 300, 1,200
Synchronization	Async
Interface	EIA RS-232-C or DAA type CBS
Error control	LRC
Emulation	Teletype
Protocol	Unblocked, blocked
Line discipline	DDD (auto answer), or multidrop polled

HEADQUARTERS

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COMPATIBILITY

Texas Instruments does not offer upward-compatible models for the 742.

The 742 is equipped with two switch-selectable line protocols; a teletypewriter-compatible nonblocked protocol that enables standard asynchronous transmission and reception of serial data characters; or a blocked protocol that enables transmission and reception of 425-character data blocks with longitudinal redundancy check (LRC) error detection.

The 742 is an ASCII-compatible terminal.

PERFORMANCE AND COMPETITIVE POSITION

The 742 is a slow-speed, low-cost, nondisplay-oriented intelligent terminal with few peripheral options. In spite of peripheral and growth-path limitations, the 742's position is, at this time, unique in the intelligent terminal market. The 742 is programmable, and its data entry control procedures are comparable to other display-oriented intelligent terminals. For a user who does not require a display-based system, but does want an intelligent system for editing and polling functions, the 742 is one of few choices on the market.

Texas Instruments sees as its competitors the Sycor 340 and the Datapoint 1100, both of which offer more sophisticated configurations. The Datapoint 1100 comes in both cassette-based and disc-based versions. The disc-based 1100 offers 16K MOS memory and is able to attach tape drives, printers, up to four diskette drives, and a 300-cpm card punch. The Datapoint 1100's transmission rate is much faster than that of the Model 742's — 9,600 bps synchronous and asynchronous as compared with a maximum speed of 1,200 bps asynchronous for the Model 742. The Datapoint 1100 can emulate the IBM 2265, 2741, and 2780, the Univac DCT 2000 and CDC 200, and the Teletype 33 ASR. The 1100 also offers upward compatibility with the Datapoint 2200 and 5500 small business computers.

The Sycor 340 is a display-oriented intelligent terminal with up to 16K bytes of memory. The 340 is cassette-based, but flexible discs may be added as an option; additional peripherals include a card reader, a cassette recorder, a line printer, and a magnetic tape unit. The 340 can attach either a binary synchronous or asynchronous communications line. Binary synchronous transmission speed can be up to 4,800 bps. The 340 can communicate with an IBM System/360 or System/370 in IBM 2770, 2780, 3780 emulation modes.

The TI 742 will probably find most of its competitors among some of the newer data entry terminals that offer intelligent data entry and editing capabilities. These systems are quite price-competitive in large cluster configurations, and in many cases offer editing features and communications options equivalent to those offered by intelligent terminal systems.

USER REACTIONS

Users of the 742 include insurance companies, credit unions, health care organizations and banks; for the most part, they employ the 742 as an intelligent data entry station. The users we contacted expressed overall satisfaction with the 742.

Automotive Dealer Services. This user was one of the first customers of the 742 terminal. The company has followed the 742 through its initial growing pains to the point at which 1,500 terminals are employed with few operating problems. Maintenance is satisfactory.

The 742 terminals are used for inventory and accounting applications (transactions, vehicle sales, accounts, debits, etc.); this data is then transmitted to an IBM System/370 Model 158. The 742 is handled by clerks, who find the terminals relatively easy to operate. The company has developed its own programs using both TICOL and Assembly languages.

Health Care Organization. A national health care organization has 742 terminals located in 100 physicians' offices where patient information is immediately entered into the organization's files. A TI 960 minicomputer configured as a Terminal Polling System (TPS), polls data from the 100 Model 742 terminals, and, at night, transmits this data over WATS lines to three IBM System/370 Model 158s for processing.

This organization uses TICOL in developing its own programs. Overall, it finds the 742 reliable, with TI's maintenance service very good. For these reasons, the user plans to set up additional terminals in a greater number of physicians' offices.

Automotive Distributor. This user employs the 742 terminals for parts inventory as well as for accounting. The distributor now has 150 terminals in operation, with expansion plans underway. Data is transmitted directly to the user's Burroughs B 4700 host computer. For this user's purpose, the terminals are fast enough as well as reliable. He reports that maintenance is excellent.

Manufacturer. For the past 2 years, this manufacturer has used approximately 500 Model 742s for data transmission, parts inventory, and some accounting jobs. The terminals suit the company's needs so well and maintenance has proven so satisfactory that the user is now adding additional terminals. All the company's data is transmitted directly to an IBM System/370 Model 158. His operators have no trouble using the terminals.

Retail Industry. A large company that owns department stores nationwide has a network of 742s used for accounts receivable/payable. The firm is more than satisfied with the overall operation of the 742 terminals, and, in fact, attributes an increase in productivity to the terminals. All programming was provided by Texas Instruments, and functions well. Downtime is minimal, maintenance is satisfactory, and the operators report no trouble in using the terminals.

This user has one criticism, however, that is forcing the company to reevaluate the 742. Its transmission speed is too slow for the host computer, an NCR 251. Texas Instruments' solution is to provide additional hardware such as the new nine-track tape drive or the TPS 700 Terminal Polling System. This user believes that both choices are too expensive and is considering conversion to direct data entry keystations.

SYSTEM DESIGN

The basic 742 desk-top unit includes a keyboard/printer, microprocessor, 8K bytes of read-only memory (ROM), dual cassette drives, and a communications interface. Options, which include an internal Bell 202-compatible modem, an EIA interface for one external peripheral device, and extended communications, must be factory installed at the time of purchase; they cannot be added in the field. Memory expansion is also available; this includes an additional 2K of random access memory (RAM) for more complex application programs and an additional 2K of read-only memory (ROM) for the more powerful TICOL II.

Processor. The system processor includes one accumulator and seven general-purpose registers; each register holds 11 eight-bit bytes plus sign. The processor allows loading and execution of application programs independently of communications. Facilities for error checking include check digit verification, range checking, key verification, and field validity, among others. Accumulation of totals and numeric calculations (add, subtract, multiply, divide) are also standard.

Tape Cassette Drives. Tape records are 86 characters long with preamble, control, and postamble characters added. Two switch-selectable formats are available for data recording:

- A line format with each block of data corresponding to one line of print.
- A continuous format with a code designating end-of-record, allowing more than one line of print per tape record.

The tape units use Phillips-type cassettes and record at 800 bpi on two tracks (one track per side). Capacity is 288K characters per cassette (144K characters per track); each cassette holds 300 feet of tape. The maximum bit error rate is specified at 1 to 10^6.

Keyboard Printer. The printer is the same nonimpact printer used on the rest of TI's "Silent 700" line. The ASCII keyboard of 58 keys includes the 12-key numeric cluster; it generates the 97-character USASCII code. The printer uses a friction-fed platen. Both upper- and lowercase are printed using a 7 x 9 matrix for uppercase and a 5 x 5 matrix for lowercase. It prints 10 characters per inch, 80 characters per line, and three or six lines per inch, vertically and switch-selectable. The system must use TI No. 213714 thermographic printing paper.

PERIPHERALS

The 742 can attach either one EIA RS-232-C- or one Direct Access Arrangement (DAA)-type CBS interface that can be used to drive either an impact printer or a magnetic tape drive. Interfaces must be factory installed at the time of purchase.

The 742 can attach any Centronics 300 or 500 Series printer. TI also offers a nine-track magnetic tape drive that operates at speeds of 800 or 1,600 bpi. Information from the system cassette is transferred to the magnetic tape; this reel is then physically transported to the host computer.

DATA COMMUNICATIONS

The standard communications facility for the system includes switch-selectable, serial-by-character or 425-character block transmission.

- The serial-by-character mode is teletypewriter compatible; it does not include error checking or acknowledgment procedures.
- Block transmission includes LRC error detection with ACK, NAK, and ENQ characters for acknowledgment procedures.

An extended communications option includes an answerback memory that allows serial transmission of up to 21 ASCII characters as a station identification (ID). It is triggered by the ENQ character or automatically, as determined by the user at the time of ordering. The reverse channel option allows the 742 to transmit a reverse channel while in the receive mode to indicate to the receiving device that communication is still established; in the transmit mode, the 742 will recognize loss of the reverse channel from the receiver and disconnect automatically after a suitable wait.

One of two line disciplines is present at the factory — either Direct Distance Dialing (DDD)/network or dedicated polled multidrop. The DDD network discipline allows auto answer or manually initiated calls. Both extended communications options operate with the DDD discipline.

The multidrop dedicated line discipline allows the system to operate in a local polled network. The station ID is a switch-selectable single character; the receiving device

can determine the status of terminal functions. The extended station ID option can be used with the multidrop discipline but not with the reverse channel option.

The standard EIA RS-232-C-type interface allows the 742 to be connected to Bell 202C- or 202D-compatible data sets (1,200 baud) or to Bell 103A- or 103F-compatible sets (300 baud or less). The optional internal is 202 Series-compatible with frequency shift keying for presentation to a CBS Data Access Arrangement (DAA). This model also supplies controls needed for automatically answering and manually originating calls over DAA.

The 700 Terminal Polling System (TPS) communications package automatically collects data from remote 742s, generating a hard-copy event log including communications abnormalities. The 700 TPS monitors the status of communications lines and data terminals, verifies transmission formats, performs parity and LRC checks, and acknowledges transmission in progress and call completion.

SOFTWARE

All terminal functions are controlled by the Model 742 microprocessor. Local operation, as well as operation in the line mode, is supervised by control programs stored in Read-Only Memory (ROM). Various utility subroutines are also in the control programs in ROM. The programming effort is, therefore, minimized for each application.

Using Texas Instruments' Cassette Operating Language (TICOL), the user can develop his own application programs, which are stored on a magnetic tape cassette and loaded into Random Access Memory (RAM).

There are two levels of TICOL (TICOL I and II); both employ three-decimal numbers for labels and field lengths, three-character mnemonics for operation codes, and commas for operand delimiters. If the maximum instruction length of 60 characters is not surpassed, comments can be added after the operand. Editing and debugging under program control are relatively simple procedures because each instruction is ended with a line feed/carriage return and recorded as one block of tape.

TICOL I has 75 variable-length instructions and is designated as a "beginner's language," a starting point in learning how to program the Model 742. All instructions contained in TICOL I are also contained in TICOL II, and all programs written in TICOL I will operate on a Model 742 that has the memory expansion facility (TICOL II is standard with this memory feature). See Table 2 for some typical TICOL instructions.

TICOL II is composed of 112 variable-length instructions (up to 60 characters long) oriented toward "fill-in-the-blank" data entry and terminal control functions. It is designed for more complex applications than TICOL I. Enhancements offered by TICOL II include: faster search, easier data transfer, binary arithmetic in memory, relative addressing and jumping, and faster table look-up.

Table 2. Typical TICOL I Instructions

Print	
PRN	Print from memory
PML	Print multiple
PFD	Print contents of field
PSF	Print contents of subfield
PRG	Print register
Branch	
JMP	Jump
CAL	Call subroutine — 2-level
RET	Return
Arithmetic	
ADD	Add
SUB	Subtract
MPY	Multiply
DIV	Divide
INC	Increment register by 1
DEC	Decrement register by 1
BAD	Binary add
BSB	Binary subtract
Compare	
TRJ	Test register and jump
CSJ	Compare subfield and jump
CRJ	Compare range and jump
Data Transfer	
DUP	Duplicate data in entry buffer
RJS	Right justify subfield
MOV R	Register to register or subfield
MOV S	Subfield to register
REC	Entry buffer to record
RCJ	Entry buffer to record and jump
SAV	Save; subfiled to memory
RTV	Retrieve; memory to subfield
Program Directives	
NSF	New subfield
NFD	New field
NFJ	New field and jump
CLS	Clear subfield
CLF	Clear field
CLB	Clear entry buffer
ERR	Set error mode
END	Return to normal mode
LEX	Load and execute new program
SRH	Search

Both levels of TICOL provide standard utility programs aimed at facilitating programming. These programming aids are contained in the Model 742 Programmer's Starter Kit, and include:

- A TICOL generator that aids the programmer during generation of TICOL programs by adding delimiters where instruction fields are fixed, providing tabbing and monitoring the amount of memory required by the program being used. In addition, this generator program watches for syntax errors so that corrections can be made immediately.
- A TICOL lister that assigns and prints a line number for each instruction, prints special graphic symbols for various characters, and provides a specialized listing of TICOL programs.
- A TICOL editor with which the user is able to edit a TICOL program.
- A TICOL translator that converts the higher level TICOL to a machine-level language. After the translator program is executed, no operator interface is necessary. The translator is both single pass and self-running.

MAINTENANCE AND SUPPORT

Texas Instruments is a well-established manufacturer of computers, computer-related devices, and components, with sales and service offices located throughout the United States, Canada, and Europe. Parts for repair or replacement of defective components are free of charge for one year from date of shipment; labor and transportation are free within a 25-mile radius of a service center for 90 days after shipment. Customers will be billed for service expenses on calls resulting from other than a TI equipment fault.

Preventive inspections are not included in maintenance contracts, as TI claims they are not required. The firm charges for travel time and expense to installations beyond 25 miles and for service during other than prime shift (8:00 a.m. to 5:00 p.m., Monday through Friday). TI has 20 service centers located in the United States, one in Canada, and three in Europe.

PRICE DATA

Model Number	Description	Purchase Price (Maint. not Included) $	Monthly Rental (Includes Maint.) $	Monthly Maint. $
742	Microprocessor, 8K Read-only Memory (ROM), ASCII code, EIA RS-232-C serial interface, & dual tape cassettes	4,925	230	42
742 MTS	Magnetic tape drive	10,670	515	100
	Memory expansion feature	495	20	N/A
700 TPS	TI 960 minicomputer, 48K memory, 9-track tape drive, 733 ASR console, 1,200-bps modem; transmission-in-progress/call completion acknowledgment, transmission format verification, parity LRC checking & continuous status monitoring for polling 742 terminals	28,425	1,200	325
	Optional with the 700 TPS: communications module that includes 1 1,200-bps touch-tone or pulse-dial modem, 1 auto call unit, & 1 DAA cable a max of 3 modules can be added to the basic system for 4-line capability	1,100	50	10

TEXAS INSTRUMENTS

Model 770 Programmable Data Terminal

OVERVIEW

There's nothing tentative about Texas Instruments' invasion of the distributed-processing marketplace. The series 700, Model 770 is but the first step in a new phase of Texas Instruments' corporate commitment to becoming a full-service supplier to large end-users, system houses, and OEM buyers. Until now, the company's intelligent terminal offering was limited to the Model 742, which was programmable, had hard copy output, but contained no CRT screen for production-oriented data entry applications, one of the current requirements for a terminal in a distributed processing environment. Now the stand-alone, integrated, desktop unit—Model 770—has made up for that deficiency. It is equipped with: a 1,920-character CRT, an optional, integral Silent 700 30 cps nonimpact printer, dual minicartridge tape drives, a 96-character ASCII typewriter-styled keyboard with separate numeric keypad, cursor controls, user programmable function keys. TI's TMS9900 microprocessor controls terminal operations and an optional Model 810 impact printer is available. Communications packages are offered with speeds up to 9600 bps for emulating IBM3780, Teletype, and TI742 terminals. An internal modem or interface kit for an external modem is provided.

Communications capabilities are strictly optional, as is program development software. If the software options are desired, random access memory (RAM) is expandable to 24K bytes for user application programs and system utilities. User data files, programs, and the utility program for specifying communications parameters to the host computer are loaded into RAM memory from the tape cartridge. A real-time, multitasking executive program called TX770 resides in read-only memory (ROM), and provides for communications with the terminal operator, file management, task scheduling, and device input/output.

Potential applications for the Model 770 include order entry, inventory control, sales analysis, invoicing, payroll, freight billing and scheduling, insurance claims processing, data preprocessing for transmittal to a host computer, and local report generation. According to TI, the Model 770 can support up to nine concurrent tasks, although no statement is available on the impact of this number of tasks on system throughput. Unattended operation is possible by the autocall and autoanswer options; the unit can also be used with TI's Terminal Polling System hardware and software for central data collection and distribution. Emulators for the IBM3780, TI Model 742, and Teletype Models 33 and 35 are available.

Texas Instruments, a well-established manufacturer of computers and related devices and components, is best known for its popular Silent 700 series teleprinters. Its only other offering in the programmable terminal marketplace is the Model 742, introduced in August 1974. TI is now dedicated to becoming a full-service supplier, with complete support and services. It will be a fierce competitor in the distributed processing marketplace, drawing heavily on its substantial technological know-how, marketing "muscle", and solid financial position.

TI's closest competitor for the Model 770 market (at $6,400 with 8K memory) is the Datapoint 1100 with 8K memory at about $6,800. Other competitors include the Mohawk Data Sciences Series 21 terminal, ADDS System 70, and Sycor 340 and 350 terminals. Datapoint and Mohawk products are diskette rather than tape cartridge based, allowing faster data accessibility through the direct-access mechanism. The Sycor 340, at about $6,780, is tape-cassette based, with floppy disk and an IBM, Honeywell, or NCR compatible tape drive as options.

Aside from the TPL Forms description language, the tape cartridge file management organization is a good selling point. It has transferred the best features of disk catalog organization to its high-speed tape cartridges. Through the file management utility, the user can display the cartridge catalog giving tape ID, version, percentage utilization, and individual file data including file name, creation date and time, and physical record length. This is a very useful capability for data storage management, emulating the file management utilities usually found on much larger machines.

Many prospective distributed processing users are concerned with the degree to which they will be giving up central control over processing programs when the local site has

program development capabilities of its own. Here's how TI responds to the problem. Since the Model 770 can be configured with or without software for program development, all processing can be controlled by down-line loading all object code from the central computer. Or, if the central site needs to maintain control over certain critical programs only, then those can be down-line loaded, leaving the local site free to develop less sensitive software on its own. Users who have thought about this problem will see that newer entrants in the distributed processing marketplace are offering an either/or capability with respect to local program development. This places the onus for software control on management rather than on the implementation technique (down-line loading). Only IBM, to date, has stood solidly behind the down-line loading concept, which automatically insures centralized control of the executable object code residing at the local sites.

COMPETITIVE POSITION

The Model 770's forte is its forms description package (called TPL Forms), which requires no programming background to develop the editing and validating specifications. However, TPL Forms compare favorably with other manufacturers' extensive data-entry systems on the market including Inforex, Entrex, Sycor, Datapoint, Data 100, Four Phase, and others. Data preprocessing and report generation capabilities are provided through the TPL Procedures language. Effective TPL700 Procedures Programming, in contrast to TPL700 Forms, requires the user to have some familiarity with high-level language programming.

SYSTEM DESIGN

Model 770 is a desktop configuration with the CRT sitting atop a full ASCII typewriter-style keyboard unit. An integral Silent 700 printer (Model 770/2 only) and the tape cartridge housings are symmetrically placed on either side of the printer.

Configuration Guide

There are two versions of Model 770: the Model 770/1 consists of 8K byte memory with parity, the video display unit, two tape cartridge transports and a keyboard, the Model 770/2 is identical with the addition of a thermal 30 cps integral printer. Basic system operation is supported by a real-time, multitasking executive in the ROM.

For both models, 4K of the 8K byte RAM is user memory. Memory expansion options of 8K and 16K are available, and all expansion memory is user memory. Program development requires a minimum of 24K bytes memory, a printer, and the program development software kit. Thus, for both models, the user needs the 16K byte memory expansion option. The printer requirement for the Model 770/1 can be satisfied by including the Model 810 printer and interface kit. The graphics option can simplify the data entry process by enabling source data entry documents to be drawn on the screen as they appear on paper.

Specifications for the TI Model 770 Intelligent Terminal are shown in Table 1.

COMMUNICATIONS

Two alternatives are available for interfacing to a communications network; an internal modem with optional autocall unit, or a kit for interfacing to an external Bell compatible modem and Bell compatible 801A6 or 801C6 autocall unit. Internal asynchronous Bell 202S and T compatible modem kits for transmission speeds up to 1,200 bps are available for a leased network, with autoanswer and optional autocall units for the switched network. Internal synchronous Bell 201C compatible modem kits for transmission

Table 1. Texas Instrument Model 770 Specifications

CENTRAL PROCESSOR	
Microprocessor	TI TMS9900
Memory	
ROM	24K bytes
RAM	8K bytes with parity (std) with 4K for user. Expandable to 24K with 8K or 16K options
CRT DISPLAY	
Character Set	96 ASCII upper/lower
Characters/Line	80
Lines/Display	24
Character Generation	Dot matrix, 5x7 upper, 5x5 lower
Viewing Area	6" H x 9" W
Graphics	32 characters (opt)
KEYBOARD	
No. of Keys	88
Layout	Typewriter
Clusters	Numeric and cursor control pads, 8 function keys
Features	N-key rollover
INTEGRAL PRINTER	
Method	Matrix thermal
Speed	30cps, 60cps spacing
Paper Drive	Friction feed
Character Set	96 ASCII
Characters/Line	80
Characters/Inch	10
Lines/Inch	6
EXTERNAL PRINTER (Model 810)	
Method	Matrix Impact, bi-directional
Speed	150 cps
Paper Drive	Tractor pin feed
Character Set	96 ASCII
Characters/Line	132
Characters/Inch	10, 16.5 opt.
Lines/Inch	6/8 selectable
No. Copies	5, plus original
Vertical Forms Control (opt)	8 programmable formats
INTEGRAL TAPE DRIVE	
Media	3M DC 100A tape cartridge
No. Drives/Terminal	2
No. Tracks	2
Tape Length	140 ft.
Recording Density	800 bpi, phase encoded
Block Length	Variable
Capacity	196K bytes at 256 chars/block
Tape Speed	206 ips read/write 60 ips seek/rewind

Table 1. (Cont.)

COMMUNICATIONS	
Network	Switched, leased line
Transmission Code	8 bit ASCII or EBCDIC
Synchronization	Async or sync
Line Speed	1200/2400/4800
Terminals Emulated	IBM3780, TTY compatible, TI742
Error Control	CRC
Optional Features	Autocall, autoanswer
Internal Modem	Bell 202S and T or 201C compatible
External Modem Interface	Bell 101/113, 202, 201/208 compatible,
Compatibility	RS-232C, RS236 for ACU
SOFTWARE	
Application Languages	TPL Forms, TPL Procedures
Utilities	File Management
Executive System	TX770 ROM resident
Multitasking	Yes, up to 9
FIRST DELIVERY	June 1977

speeds up to 2,400 bps are available for a leased network, with autoanswer and optional autocall units for the switched network operation. Interface kits for external Bell compatible modems and 801A6 and 801C6 autocall units are available for asynchronous and synchronous networks.

Asynchronous transmission for speeds up to 300 bps is supported by a 103/113 modem interface kit, with optional interface for an autocall unit. For asynchronous speeds up to 1,200 bps, the 202 modem kit with optional autocall unit is available. Synchronous transmissions for 2,400/4,800 bps networks are supported by kits with optional autocall units interfacing to 201/208 compatible modems. A local serial RS232C interface port is used to connect the optional model 810 (or other) printer to the terminal.

Compatibility

Three packages are offered to allow the Model 770 to communicate with many host computers. An interactive utility program is provided with each emulator, allowing the user to specify the particular parameters and requirements of the host computer. The set of characteristics is recorded on the tape cartridge with the communications emulator, so that these characteristics will be selected each time the communications program is loaded into memory. Each communications program, including the user-specified characteristics, may be copied onto a user-generated system tape, from which it may be loaded into the memory under control of a user-applications program. Alternatively, the communications program may be loaded into the 770 memory by an operator using ROM resident operator commands.

IBM 3780 Emulator

With a synchronous communications kit option and an IBM 3780 emulator package, the Model 770 can communicate with an IBM host computer using bisync protocol. If the autocall unit option is selected, the 770 can automatically call the host computer by dialing a user-selected telephone number. IBM 3780 features include 512-character blocks, space compression and decompression, conversational replies, and component selection.

TTY Emulator

The Model 770 can communicate with time sharing services and host computers using teletype Model 33 and 35 protocol, in half- or full-duplex mode, up to 1,200 bps. An operator can communicate with a host computer in interactive mode, or can cause data files to be transmitted directly from a tape cartridge. Data files can be transmitted from the host computer to a tape cartridge or to a printer. The terminal will also operate in unattended mode and automatically answer a call from the host computer.

TI 742 Emulator

This package allows the 770 to communicate with TI's Terminal Polling System, essentially a data collection system, which has two functions: 1) it polls 742 and 770 terminals automatically using the switched telephone network and 2) it records the received data on IBM compatible magnetic tape.

SOFTWARE

Software on the Model 770 falls logically into three areas: applications development, file management utilities, and communications. Communications software is described in the Communications section of this report.

TPL 700 Forms

TPL 700 is the applications software developed specifically for the Model 770 and consists of two parts: TPL Forms and TPL Procedures. TPL Forms are used for drawing and developing field editing specifications for data entry applications. TPL Procedures is an application programming language supported by an interactive text editor, a program compiler, and an object module linker. Both TPL Forms and TPL Procedures may be used independently for forms-mode data entry and data processing applications. Or, during the forms development process, the designer may indicate that procedural code is to be executed whenever a specified field of data is entered; the procedural code is then linked to the forms module. Similarly, procedural programs can issue subroutine calls to other procedural modules. TPL Forms can be supplemented with the graphics option which enables the designer to draw the form on the screen. At data entry time, the screen image will reflect the source document for the operator, thus simplifying the data entry task.

When creating a form, the designer loads the TPL Forms program from the tape cartridge, and the following format appears:

```
                                          FIELD DEFINITION
FLD001 NAME_ _ _ _ _ _SAME AS FLD_ _ _          CROSSFIELD (Y/N)N


                                SPECIFY FIELD LEVEL ATTRIBUTES
TABSET N  CHAR TEST      2          AUTOSKIP     Y
INPUT  1    1=NO     4=MIXD 7=OTHR PROCESSING   _
 1=KEYB     2=ALPHA  5=NUM         OUTPUT       _
 2=FIXD     3=DIGIT  6=PRNTBL        1=NO
 3=OTHR                              2=FILE
VIDEO  1  LEN TEST  2 FIELD TEST _   3=OTHR
 1=HI       1=NO       1=NO  3=TBL BRANCH      _
 2=LO       2=MIN      2=RNG 4=RRY  1=NO    3=FIXD
 3=OFF      3=FIXD                  2=TEST   4=ENTR
```

The designer then proceeds to define the content of FLD001 by entering the code that matches the desired attribute. When the TPL Forms program needs more data, additional menu-picking lists will appear for that field. For example, if the designer specifies that a range check is required, the format for entering the valid range of data will appear interactively, prompting the designer to completely specify all required parameters. Highlights of the TPL Forms package follow:

- Data attribute validation is performed field by field and includes data representation, length, field mandatory, left or right justification, zero suppression, range checking, arithmetic operations, table look-up and key verification, and data substitution capabilities (that is, "Manager" will always be substituted when "Mgr" is keyed).
- Cross-field validation checks are provided with one or two sets of validation criteria exercised against data entered in a previous field.
- Fixed branching to a specified field, or conditional branching to an out-of-sequence field based on data entered in the current field is possible. Forms mode data entry traditionally proceeds left to right, top to bottom. Departures from this procedure can be specified by the forms designer in either of two ways. A fixed branch, as the name implies, causes the cursor to skip automatically to an out-of-sequence field. When the conditional branch option is selected, the cursor will skip to an out-of-sequence field only if certain predefined data is entered.
- Large forms can be designed in multiple pages with data fields passed between the pages, if necessary.
- A form can be chained to another form.
- Procedural code can be invoked upon entry of a field in a form, or after a batch of forms is completed, for more extensive data preprocessing requirements.

TPL Procedures

Using the Text Editor Utility, Procedures can be created or modified on the display screen of the 770. A program consists of a declaration section and a procedure section. In the first, the Procedure program is assigned a name and the variables, constants, and files which are used in the program are also specified. Control of the Procedure program and its interaction with other Procedure programs and subroutines is provided by such keyword commands as: BEGIN (execution of the following statements), RETURN (control to the system executive or to the main Procedure program), OVERLAY (this program with another), and CHAIN (to another program).

The sample program in Figures 1 and 2 demonstrates the use of some of the keywords and the flexibility available to the programmer in structuring a program. The sample program clears the screen, then asks the operator (by the video display) to type a number from zero to nine. If the operator selects the number seven, the terminal prints "LUCKY NUMBER-7" on the internal printer, then returns control to the system executive. However, if the operator selects a number other than seven, the terminal displays the number selected along with the message that it is *not* the lucky number and then returns control to the system executive.

In Figure 1, the program is written in a free-form or English-like manner and illustrates the use of: multiple statements and partial statements on the same line, a Boolean operation within a statement, and file commands within a statement. If the programmer's background is oriented toward rigidly structured statement-type languages such as FORTRAN, Figure 2 illustrates the same program and the same code written in a more structured fashion. It is not necessary to begin a statement in any particular column; however, the TPL Text Editor provides multiple tab settings in each line for the programmer's convenience.

```
PROC    GAME
VARIABLE  DIGIT=NUM        CONSTANT     WINNER="LUCKY NUMBER=7"   FILES PTR=80
BEGIN DISPLAY  .CLR,     "TYPE A NUMBER FROM 1 TO 9"     ENTER INTO DIGIT
IF DIGIT EQ 7 THEN PREPARE PTR WRITE PTR, WINNER CLOSE PTR ELSE DISPLAY
DIGIT," IS NOT THE LUCKY NUMBER" END  RETURN
```

Figure 1. Texas Instruments TPL Procedures Free Form

File Management Utilities

Utilities are limited to tape cartridge management, and include no generalized data-processing utilities like sorts, merges, or selects at this time. The file management utilities include: a display of the cartridge catalog giving tape ID, version, percentage utilization, date and time of creation; a utility for initializing a new tape and creating the cartridge catalog; and a utility for formatting the tape for file name, record length and number of records the file will contain. Note the similarity between the tape formatting utility which establishes the cartridge catalog and the traditional technique for pre-allocating a disk data set in tracks or cylinders before loading the data. The file list utility enables a user to page through the formatted file data by way of the CRT screen, and optionally to obtain hard-copy output using the print key on the keyboard. Using the file copy utility, a specified input file will be copied to a specified output file.

```
PROC        GAME
VARIABLE
      DIGIT = NUM
CONSTANT
      WINNER = "LUCKY NUMBER = 7"
FILES
      PTR = 80
BEGIN
      DISPLAY .CLR
      DISPLAY "TYPE A NUMBER FROM 1 TO 9"
      ENTER INTO DIGIT
      IF DIGIT EQ 7
            THEN
                  PREPARE PTR
                  WRITE PTR, WINNER
                  CLOSE PTR
            ELSE
                  DISPLAY DIGIT," IS NOT THE LUCKY NUMBER"
   END
RETURN
```

Figure 2. Texas Instruments TPL Procedures Structured Form

MAINTENANCE AND SUPPORT

During prime shift (8 am to 5 pm) travel, labor, and materials expenses within a 100-mile radius of a service office are covered by the TI maintenance contract. Beyond this radius, coverage is available at an additional $20 per month per terminal and $20 per month per external printer. A TI sales office should be contacted for prices of extended, full, and on-call maintenance coverage. TI maintains sales and service offices throughout the U.S., Canada, and Europe.

PRICE DATA

Item No.	Description	Monthly* Rental (Prime Shift Maint. Incl.) $	Purchase Price $	Monthly Maint. $
	STANDARD CONFIGURATIONS			
100	**770/1 Terminal** Contains 8K bytes memory with parity, video display unit, two mini-cartridge transports, keyboard, 115V power supply, introduction tape cartridge and operating instruction manual	280	6,400	72
101	**770/2 Terminal** Identical to 770/1, plus Thermal Printer and one roll of printing paper	390	7,500	87
	INTERNAL OPTIONS			
	Memory Expansion			
120	8K Byte Memory Expansion	20	675	
121	16K Byte Memory Expansion	29	1,075	
	Video Display			
130	Graphics Kit	8	150	
	Peripheral Interface Kit			
135	Serial Printer Interface Kit	26	795	
	Communications Kits			
140	Internal 202 Modem Kit with Auto-answer for Switched Network	40	1,065	
141	Internal 202 Modem Kit with Auto-answer for Switched Network and ACU	60	1,385	
142	Internal 202 Modem Kit for Leased Line	40	1,065	
143	Internal 201 Modem Kit with Auto-answer for Switched Network	68	1,755	
144	Internal 201 Modem Kit with Auto-answer for Switched Network and ACU	88	2,075	
145	Internal 201 Modem Kit for Leased Line	68	1,755	
150	Interface Kit for External 103/113 Modem	17	530	
151	Interface Kit for External 103/113 Modem and ACU	29	830	
152	Interface Kit for External 202 Modem	17	530	
153	Interface Kit for External 202 Modem and ACU	29	830	
154	Interface Kit for External 201/208 Modem	23	625	
155	Interface Kit for External 201/208 Modem and ACU	35	925	
	EXTERNAL OPTIONS			
170	Basic 810A Printer Kit Includes interface kit and operating instruction manual	185	2,875	42
171	810B Printer Kit with Option Package	195	3,175	42
	770 SOFTWARE			
190	770 Programmer's Kit Contains Program Development Software Minicartridge, 3 Blank Cartridges, TPL700 Programming Manual		175	
191	770 Program Development Software on Minicartridge Media		130	
192	3780 Communications Kit Contains Emulation Software on Minicartridge Media and User's Manual		50	
193	TTY and 742 Communications Kit Contains Emulation Software on Minicartridge Media and User's Manual		50	

*90-day minimum initial term

Notes:
12-, 36-, 60-month leases available
Quantity discounts available, but they do not apply to accessories, supplies, software, manuals, and field-installed internal options.

UNIVAC

Universal Terminal System (UTS) 400

OVERVIEW

The Univac UTS 400 Universal Terminal System is a family of programmable terminal configurations designed for remote, on-line applications in distributed processing environments. The UTS 400 series of intelligent, transaction-oriented terminals complements the Univac UTS 700 series of remote batch systems that were introduced at the same time. Together, the two terminal series make up Univac's new product line designed specifically for the distributed processing market.

The UTS 400 is capable of performing the following functions:

- Editing of operator input entered through the keyboard.
- Storage and retrieval of screen formats.
- Arithmetic operations and local processing.
- Reformatting of data transferred between the displays, peripheral devices and communications lines.
- Display of errors and peripheral device status.

The UTS 400 system is offered in two different configurations:

- A master display terminal with one or two slave terminals.
- An independent controller configuration with one to six slave terminals attached. Slave stations consist of a keyboard/display unit only. All slaves share a single microprocessor, working storage, and electronics; slave electronics may be installed in either the master terminal or in a separate controller.

Both master and slave stations contain their own display refresh electronics and buffers.

HEADQUARTERS

Sperry Univac
PO Box 500
Blue Bell PA 19422
(215) 646-9000

Univac has also announced the first of a series of special-purpose intelligent terminals based on the UTS 400. The UTS 400 Text Editor is designed for the printing and publishing industries; it is capable of text manipulation and text storage.

All UTS terminals are based on a microprocessor that controls slave displays, communications, and peripheral devices. Read-Only Memory (ROM) firmware is used for storing basic system functions, and read/write memory is used for working storage and user programs.

The UTS 400 can be configured with up to 8 optional peripheral devices; tape cassettes and diskette drives for auxiliary storage, and a variety of line printers.

Communications are supported over voiceband, switched, or private lines. Synchronous transmission rates are up to 9,600 bps and asynchronous rates are up to 2,400 bps.

The UTS 400 series was announced in April 1976. First deliveries are scheduled for the third quarter of 1976. See Table 1 for UTS 400 system specifications.

Table 1. Univac UTS 400: Specifications

PROCESSOR	
User Memory	24K bytes
Read-only Memory (ROM)	12 to 40K bytes
No. of terminal stations	1 to 6
Max. no. of I/O devices	8
KEYBOARD ENTRY	
Console layout	Typewriter, numeric pad, function keys
Code set	ASCII
Programmable keys	7
CRT DISPLAY	
Screen Size (in)	10 x 7
Lines	12, 16, or 24
Char/Line	64 or 80
Char/Set	64 or 96, international sets opt
PERIPHERALS	
Cassette	2/subsystem, 600-bps data transfer, 720,000-byte capacity/cassette
Diskette	31,000-bps data transfer, 256,000-byte capacity
Thermal Printer	300 cps, 96 char, 80 col
Char Printer	30 cps, 63 char, 132 col
COMMUNICATIONS	
Line Facility	Voiceband, switched, private
Transmission Code	ASCII
Data Rate	2,000 to 9,600 baud sync 300 to 2,400 baud async
Transmission Mode	Half-duplex

COMPATIBILITY

The UTS systems are completely compatible with Univac host machines and support either synchronous or asynchronous communications protocols. All transmission is performed using the ASCII character code set. Program preparation facilities are supported only on Univac host processors.

To allow for an orderly transition for present customers who may be using Uniscope terminals in their current applications, the UTS terminals support a built-in Uniscope® emulation facility.

PERFORMANCE AND COMPETITIVE POSITION

With the announcement of the UTS Series, Univac has entered the distributed processing arena with a family of systems designed specifically to act as complimentary products to the Univac line up of communications offerings. The UTS 700 remote batch systems are powerful telecommunications and stand-alone processors; the UTS 400 line provides facilities for interactive terminal environments.

Univac's primary competition is, of course, IBM, and the announcement of the UTS series is Univac's attempt to go one better than IBM, which announced a variety of distributed terminal systems in the past year (the 3600 Series of financial, retail, and supermarket terminals, and the 3790 data entry system).

®*Uniscope is a registered trademark of Univac.*

The UTS product line also marks Univac's entrance into the small systems area, which it has hitherto avoided. It is common industry knowledge that Univac has been working on a small systems processor; whether or not the UTS Series is a prelude to a foray into the small business computer arena is a matter of conjecture. However, it is a short jump from a sophisticated terminal line to a fully capable, stand-alone small business computer.

The UTS 400 has been designed to effectively function as a multi-purpose intelligent terminal for a number of environments.

- In data entry applications, the terminal system may be programmed for fill-in-the-blank completion of forms on the display screen. Considerable validation of the entered data may be performed by the terminal system itself.
- In data access, or information retrieval applications, the terminal system may be programmed to perform display formatting at the distributed processor, thus reducing the volume of data transmission across the lines and minimizing the processing load on the host machine.
- The UTS system may also be used as a control console for specialized applications; status change information is updated by the host machine, and operator control instructions may be passed back to the host.
- The UTS system may be programmed as an off-line data handling system. It can perform editing functions and control attached peripherals (including file storage on either diskette or cassette media). Files can be constructed off-line and at a subsequent time be transmitted to the host processor for further work. Similarly, reports may be transmitted to the

UTS system for storage on the media files and later displayed or printed in an off-line mode.

The UTS Series begins where the older Uniscope ® terminal series leaves off. The standard UTS 400 system includes:

- Field control character program control.
- Back tabbing.
- Line duplication.
- Line insertion and deletion.
- Data retransmission.
- Peripheral device control and buffering.
- Automatic peripheral retry.
- Automatic answer/hangup.

Many of these features may be controlled by either the UTS operator (running under local program control) or remotely, by the host processor.

Field control of the UTS CRT screen is versatile. Field control indicators do not occupy screen positions (as they do, for example, on the IBM 3270). Fields may be displayed at high or normal intensity or blinking or may be suppressed. Field control can also be used for a variety of validation functions: alpha or numeric-only fields, field protection, or left or right field justification. Field tabbing and operator modification of field indications are also supported. A special operator accessible switch allows the UTS 400 to use the field control functions in Uniscope® mode, thus allowing operation of the UTS terminal without requiring host processor application software modification.

In addition to operator function key control of message transmission across the communications lines, the operator may also initiate message transfer to attached peripherals. If the selected device is available, the transfer occurs immediately; if the system is equipped with a buffer pool option, the message is placed into the buffer pool for transmission, and the screen is freed for the next operator entry.

For large terminal configurations, Univac offers a terminal multiplexor, which may be connected to up to 16 UTS terminal systems, either masters or independent controllers with slaves. Multiplexor ports may also be assigned to Uniscope® devices. The multiplexor will select, on a priority basis, from among the connected devices and transmit over a single communications line to a host processor.

Because the UTS 400 is tied to the apron strings of a Univac mainframe, it will be essentially free from incursions by independent terminal manufacturers. The UTS 400 is a class of device like the Burroughs TC Series Terminal Computers; both are offered as a single product within a full product line. While the Burroughs TC Series has a COBOL compiler, Univac has not given the UTS 400 this capability, thus retaining strict central site control over its operation. Aside from this difference and the difference in actual physical appearances (the UTS equipment is CRT based; the TC equipment is oriented to hard-copy printing), the UTS line has implemented some of the proven techniques of the TC terminals. Included among them are: user programs are isolated from the complexities of communications line handling, and program loading can be performed over communications lines by operator request. Univac has also paid particular care to the problem of system uptime: considerable error checking circuitry is built into the devices; automatic power-on confidence test routines are a standard feature of the system; and error logging and line monitoring facilities are provided.

SYSTEM DESIGN

There are two basic versions of the UTS 400:

- A stand-alone controller capable of supporting from one to six slave display devices.
- A master display terminal that integrally contains the controller electronics and is capable of supporting one or two additional slave displays.

Both system versions may make use of all available communications options, and support up to eight peripheral devices. The UTS 400 includes 12 Device IDentifers (DIDs) for the attachment of peripheral devices. Each DID represents a read or write station, thus a printer uses one DID and a cassette or diskette uses two DIDs.

Central Processor

The central processor of the UTS system is a microprocessor that controls all attached slave displays, communications, and peripheral devices. From 12 to 40K bytes of read-only memory (ROM) is used for built-in system functions, and random access memory (RAM) is used for working storage and user programs. Up to 24K bytes of storage is available for user programs and data buffers.

Keyboard/Display

Each slave display consists of a CRT screen and a keyboard. The CRT can contain 12, 16, or 24 lines with 64 or 80 characters per line on a 10-by-7-inch viewing area. Characters are displayed using a 9-by-7-dot matrix grid; 64 characters are standard, and a 96-character option including lowercase is available. The keyboard includes a typewriter section, a numeric pad, and 22 special function keys, seven of which operate under program control. The keyboard/display can be configured with several languages for international usage.

PERIPHERALS

The UTS 400 supports cassette or diskette for auxiliary storage, as well as a variety of line printers. There are 12 peripheral Device IDentifers (DIDs) for supporting peripherals. Each peripheral requires a specific number of DIDs; the number of peripherals attached to any UTS 400 system is dependent upon the number of DIDs they require. Eight peripherals is the actual maximum number of devices that can be attached to a UTS 400.

Cassette

A cassette subsystem, which uses four device DIDs, may be attached. The subsystem consists of two cassette drives, each capable of holding 720,000 bytes of data. The cassettes perform data transfer operations at the rate of 600 bps. Cassette operations can be initiated either by operator command, program execution, or by the host processor.

Diskette

A diskette subsystem, which uses two DIDs per drive, may be attached to the system. The diskette subsystem consists of a single drive with a capacity of 256,000 bytes of storage. Data transfer rate for this device is 31,000 bps. It, too, may be controlled by the operator, the program, or the host computer.

Printers

Univac offers two printers. The Model 800 is a nonimpact thermal printer operating at 300 cps with an 80-column line. Also available is an impact printer, capable of printing up to six copies at 30 cps with a 132-column print line. Several printers may be attached to a single controller or master station.

Terminal Multiplexor

A terminal multiplexor is available for multiplexing up to 16 UTS 400 systems to a single telecommunications line. The multiplexor also supports connection of Uniscope® and UTS 700 equipment.

DATA COMMUNICATIONS

The UTS 400 always operates in a polled environment, with all transmission initiated by the host processor. All communications traffic is addressed and all messages are acknowledged by the UTS system firmware; the operator and program are concerned only with message content.

The UTS 400 can be operated over the public telephone network (with Univac-supplied modems) on leased voice grade lines or over a private communications line. Slave clusters are connected to a communications line through a common multiplexor; in a multiplexed configuration, the multiplexor determines the priority of response to a host computer poll.

Transmission is performed using seven-level ASCII codes with character parity. Synchronous transmission speeds up to 9,600 baud and asynchronous speeds up to 2,400 baud are supported. Each terminal system operates in half-duplex mode; however, the UTS 400 is so designed that a full-duplex communications line can be put to effective use if shared by several terminal systems; the host processor can poll one UTS 400 while receiving a data transmission from another connected to the full-duplex line.

SOFTWARE

The UTS system is programmable by the user, utilizing one of two compilers on a Univac Series 90 Model 90/30, 90/60, 90/70, 90/80 and 1100 Series mainframe system. The assembly level compilers will be available starting in December 1976. Known as PLM and MAC 80, they will be part of software releases for the Univac mainframes. Once generated, such programs may be transferred to the UTS 400 in three ways:

- Explicit terminal operator request.
- Host machine application program.
- UTS 400 program control.

In all three cases, the program is transmitted from its storage location in the host processor to the terminal system.

Firmware functions are stored in read-only memory (ROM) and are not subject to modification. Included in the firmware are the communications protocol functions and peripheral control drivers; interfaces to the user programs are provided to access these elements. The UTS 400 has not been designed as a freestanding processing system, and thus has been optimized for the communications environment. Since programs are all generated at a host machine, there is no requirement to dedicate special electronics or media to generation, loading, or storage of programs. However, if a system is configured with media storage, programs can be directly loaded to the UTS 400.

The programmability of the UTS system is adequate for most common distributed communications environment tasks. Program functions that users may implement include:

- Data validation, including range checking, field comparisons, and restrictions on fields.
- Data formatting, including transmission message construction, reordering of fields, and text compression.
- Arithmetic operations at the terminal site.
- Implementation of security features such as password or access codes.
- Specialized user guidance, including prompting messages on the screen and programmable highlights of selected fields.
- Definition of special operation sequences initiated by operator depression of specific key sequences.
- Construction of transaction entry logs or other file types to attached media devices.

The UTS 400 is a single-task system, even though several operator terminals may be attached. Only one program may be in effect for all slaves within a cluster. If more than one application must be active at a given time, then the application functions must be combined into a single program.

The UTS 400 Text Editor comes equipped with application software tailored specifically to the needs of the printing and publishing industries. The system is designed for use in conjunction with a Univac 9000 Series mainframe machine, and allows for text entry and editing, and the construction of typesetting composition instructions within the text body. Specialized functions such as split screen (double columns), stored text formats, and text modification are included. The Text Editor is presented as a turnkey system, with no requirement for the user to implement his own terminal programming functions.

MAINTENANCE

Univac maintains the UTS terminal systems with the same maintenance force used for service of the mainframe systems. Maintenance is included in the rental terms for the systems, and maintenance contracts are available for purchased units.

PRICE DATA

Model Number	Description	Purchase Price (Maint. not Included) $	Monthly Maint. $	Monthly Rental (Maint. not Included) $
3544-99	Univac UTS 400 Master	5,720	38	143
8594-00	UTS 400 Terminal Controller	3,120	21	78
3548-99	UTS 400 Slave	3,000	20	75
F2271-01	Generator Expansion	640	—	16
F2273-00	Keyboard Uppercase - 64	680	3	17
F2273-01	Keyboard Uppercase - 96	680	3	17
F2276-00	Function Keyboard Expansion	80	1	2
F2278-00	Display Drive	440	2	11
F2286-00	Sync Interface - 4,800 bps	680	4	17
F2286-01	Sync Interface MIL 188	680	4	17
F2286-03	Sync Interface - 9,600 bps	1,080	4	27
F2288-00	Async Interface	680	4	17
F2288-01	Async Interface MIL 188	680	4	17
F2284-00	Peripheral Interface - 8	600	—	15
F2285-00	Peripheral Interface - 7	520	—	13
F2281-00	Storage Expansion - 8K	1,320	2	33
F2283-00	Screen Bypass	720	2	18
8541-06	Communication O/P Printer	2,596	25	67
F1780-00	Variable Forms Control	195	1	5
0866-97	Tape Cassette System	1,947	24	56
F2142-00	Feature Group D	577	—	14
F2142-01	Feature Group E	906	—	24
8538-99	Terminal Multiplexor	1,781	6	45
F1264-00	Multiplexor Expansion	356	—	11
8538-97	Terminal Multiplexor	1,680	6	44
F1266-00	Sync/Async Interface	356	—	11
8406-00	Diskette Drive - 100/120V	3,960	16	99
F2338-00	Drive Expansion - 100/120V	1,440	9	36
F2290-00	Auto Answer/Hangup	120	1	3
8406-02	Diskette Drive - 200/240V	3,960	16	99
F2338-02	Drive Expansion - 200/240V	1,440	9	36
3549-99	UTS Text Editor	7,420	43	283
F2545-00	Storage Expansion - 4K to 12K	960	2	24
F2545-01	Storage Expansion - 12K to 20K	960	2	24
F2582-00	Auto Answer/Hangup	120	1	3
F2544-00	Peripheral Interface - 8-bit	600	—	15
F2543-00	Peripheral Interface - 7-bit	520	—	13
8541-06	Communication O/P Printer	2,596	25	67
F1780-00	Variable Forms Control	195	1	5
0866-97	Tape Cassette System	1,947	24	56
F2142-00	Feature Group D	577	—	14
F2142-01	Feature Group E	906	—	24
8538-99	Terminal Multiplexor	1,781	6	45
F1264-00	Multiplexor Expansion	356	—	11
8538-97	Terminal Multiplexor	1,680	6	44
F1266-00	Sync/Async Interface	356	—	11
8406-00	Diskette Expansion - 100/120V	3,960	16	99
F2338-00	Drive Expansion - 100/120V	1,440	9	36
F2537-00	Async CI	680	4	17
F2537-01	Async CI-MIL 188	680	4	17
F2539-00	Sync CI-RS232C	680	4	17
F2539-01	Sync CI-MIL 188	680	4	17
8406-02	Diskette Drive - 200/240V	3,960	16	99
F2338-02	Drive Expansion - 200/240V	1,440	9	36
3038-99	Basic UTS 700 System w/48K Storage	12,290	71	291

PRICE DATA (Contd.)

Model Number	Description	Purchase Price (Maint. not Included) $	Monthly Maint. $	Monthly Rental (Maint. not Included) $
F2377-00	BSC Capability	325	2	8
F2307-01	Storage Expansion - 16K	1,470	5	34
F3545-99	Workstation - CRT/KB	3,600	22	86
F2365-99	Dual Diskette - 100/117V	5,675	30	132
F2365-97	Dual Diskette - 200/208/220V	5,675	25	132
F2380-00	Disk Drive - 5MB	13,459	75	313
F2380-04	Disk Drive - 10MB	20,296	90	472

DIRECTORY OF SUPPLIERS

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Trumbull CT 06609
(203) 377-4141
ELECTRONICS DIV
31717 La Tienda Dr
Westlake Village CA 91360
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WORLD HDQTRS
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NEW YORK CITY DATA CTR
80 Pine St, 10th Fl
New York NY 10005
(212) 952-7333

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COMPUTEK
63 Second Ave
Burlington MA 01803
(617) 272-8100

D

DATAPOINT CORP (FORMERLY COMPUTER TERMINAL CORP)
9725 Datapoint Dr
San Antonio TX 78284
(512) 699-7000

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1190 Dell Ave
Campbell CA 95008
(408) 378-1112

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(617) 897-5111

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